ELECTRICAL WORLD

JUNE 4, 1938

PRUDENT MODERNIZATION

SKILLFUL REHABILITATION AND EXPANSION OF AMERICAN POWER SYSTEMS TO MEET GREATER CUSTOMER DEMAND THROUGH METHODS THAT CONSERVE INVESTMENT WITHOUT SACRIFICING QUALITY OF SERVICE

E. E. I. CONVENTION NUMBER

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Letters TO THE EDITOR

Cable Gains Offer by Manufacturers' Inspection Tax

To the Editor of ELECTRICAL WORLD:

The article by Mr. Turbyfill dealing with cable inspection costs of the Commonwealth Edison Company which appeared in your March 26 issue is a very interesting analysis of the traceable money value of cable inspection and the cost of such inspection. However, certain findings in the analysis should be emphasized.

1. The sole reason why the present-day cost of thorough inspection at the factory is greater than the capitalized value of the immediately traceable defects eliminated which can be so capitalized *is found in the practice of the manufacturers since 1934 of charging any customer 2 per cent extra if he chooses to inspect his cable at the factory to assure himself that he is getting what he has ordered and specified.* Fig. 4 shows that, for at least paper-insulated cable rated at 5 kv. and higher, the probable saving due to the elimination of serious defects and deficient copper resulting from competent inspection at the factory is materially greater than the direct cost of such inspection. In other words, inspection itself effects a saving of something like nearly 1 per cent, but this is far more than canceled by the 2 per cent tax imposed by the manufacturers.

2. As shown by the shaded portion of Fig. 1 and by Fig. 2, the cost of the more thorough inspection which is practicable at the factory would be insignificantly greater than inspection on delivery, which is necessarily limited, were it not for the tax of 2 per cent imposed by the manufacturers.

3. It is clear that under present conditions the total cost of complete factory inspection of high-voltage, paper-insulated cable (5 kv. and over) averages about 3½ per cent of the cost of the cable. Of this, an average of about 1½ per cent is recovered through the elimination of seriously defective cable and low copper area. The question before the purchaser is whether the remaining advantages of factory inspection are worth the balance of 2 per cent represented by the manufacturer's tax. These advantages include:

(a) The psychological value of careful inspection is unquestionably of very considerable value. The moral effect on both the purchaser's staff and the manufacturer's staff must be helpful. Preparing and purchasing under carefully prepared specifications and then expending a minimum effort to check purchases thereunder is not conducive to the highest respect for the specifications by either group.

(b) The more comprehensive inspection at the factory discloses many of the less vital failures to comply with the requirements of the specifications as shown in Fig. 3. In addition to the psychological value of this information to the purchaser in dealing with the manufacturers, it often provides factual justification for changes in the specifications, and it also permits the development and application of a more reliable means of evaluating the relative "quality" of cable of different types, different makes, different vintages, etc. This information should be of not insignificant tangible value to the purchaser.

(c) Many of the cable manufacturers have repeatedly conceded that competent inspection by outside agencies is of very definite value in maintaining quality, particularly where the volume of inspection and test data which can be combined permits statistical analyses. Any admitted value to the manufacturers is of course a value to the purchaser.

Whether these "supplementary" advantages of inspection of high-tension cable are worth while despite the 2 per cent tax by the manufacturers is for the users of this product to decide. But, let the decision be made with full knowledge of all of the facts.

Finally, it should be recognized that any calculation of the loss incurred by any one purchaser when he discontinues inspection should take into account the beneficial influence of continued inspection by other purchasers. No one can say what the effect would be if *all* inspection of cable by *all* purchasers were discontinued. However, we do know the effect of the reverse procedure, because there is a wealth of information in this and other fields which shows how improvement of a product has followed the introduction of a competent and sustained inspection policy.

F. M. FARMER,
Chief Engineer
Electrical Testing Laboratories,
New York, N. Y.

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Clarifies Voltage Term in Cable Temperature Rating

To the Editor of ELECTRICAL WORLD:

In the ELECTRICAL WORLD, March 26, 1938, my article "Design Station Cables on Conservative Basis" looks well in print and I was very well pleased with the general arrangement. However, there are a few corrections which I believe should be made with the thought of making the article a little clearer.

I believe that the footnote on page 39 would be a little more accurate and more enlightening if it read as follows:

E is the voltage to neutral in kilovolts for single-conductor cable and all types of shielded cable.

E is the voltage between lines in kilovolts for non-shielded multi-conductor cable.

On page 40, column 1 in the panel, lines 2 and 3 should read "or else" instead of "less frequently."

F. H. BULLER,
Central Station Department,
General Electric Company,
Schenectady, N. Y.

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Lightning Zigzags Symmetrically

To the Editor of ELECTRICAL WORLD:

In the April 9 issue of ELECTRICAL WORLD I note references to two noteworthy lightning flashes and call your attention to this:

A flash of lightning occurred in this locality in September, I believe, 1932, which I called to the attention of the Weather Bureau observer and to that of a newsgatherer, but have not seen in print.

From a cloud not less than 7 miles and probably nearer 10 miles south of me a zigzag flash of red hue (scarlet to crimson) traveled to a cloud about ¼ mile north of me. I estimated the path to be from 17 to 20 miles, along the zigzag line. The bounds of the zigzag line were two parallel (imaginary) lines spaced about the length of the apparent diameter of the moon or less. The angle of the zigs and zags was possibly 60 deg. or less and the entire flash was a flawless geometrical design of perfect symmetry from cloud to cloud.

Walking south from the village of Newberry on the state highway I was looking for a repetition of a funnel-like cloud, *i.e.*, an aerial "twister," which I had reported to the Weather Bureau observer a day or two previously, when I sighted a second twister due south in Mackinac County, and almost as I sighted it the flash described came out of a cloud next to it traveling at an easily watched speed until it reached the cloud over and behind me.

My estimate of 17 to 20 miles overall length should be accepted as accurate. I spent a year as first tower man to occupy a fire tower here and I learned to measure aerial distances rapidly and accurately.

R. R. RYAN,
Newberry, Mich.

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ELECTRICAL WORLD

JUNE 4, 1938

Prudent Modernization

UNTIL the slight current interruption, the load on the power systems of this country was increasing at a rapid rate—increasing at a time when rates were falling substantially, when taxes and other costs were increasing, when large quantities of capital for new investment were not available. When other industries were striving to reach the peak volume attained in 1929 the American power companies had already passed their previous peaks and were straining their facilities. Here was a dilemma the answer to which was found in prudent modernization.

In other words, the policy of uninterrupted and adequate service at all times, which has been the guiding principle of the electric utility industry since its beginning fifty-six years ago, demanded more capacity—capacity in station, in lines, in substations, in buildings, in customer service. This added capacity could have been procured by entirely new construction, but it has been essential to conserve investment and to assure a reasonable return on that investment. The only way this could be accomplished was by a program of rehabilitation that would extend the capacity of existing facilities as far as possible. This conservation of investment without sacrifice of quality of service is prudent modernization—prudent in that it efficiently meets current needs, prudent in that it takes economic advantage of technical advances, prudent in that it provides appropriately and wisely for future load requirements.

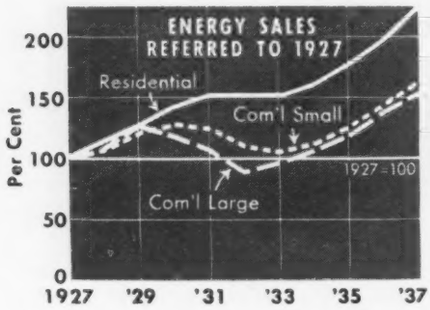
In many respects the industry is stronger for having had to provide service under these difficult economic conditions. Force of circumstances has shown the way to investment economies that had withstood solution during more prosperous times, although the problem of a lengthening time of capital turnover was fully recognized. This is the utility industry's most fundamental problem, how, in spite of lower rates and greater costs, to speed up capital turnover, or at least prevent it from becoming any longer. Obviously, the answer is a greater use of existing facilities.

How to procure this greater use is a problem not to be answered by any one solution. It requires a combination of activities. Thus selective selling whereby load growth is co-ordinated to system requirements is one element. Another is the future pattern of generating systems to minimize the amount of adequate reserve capacity. Then there is interconnection, system planning both as to immediate requirements and future pattern, rate structure for loads of unusual characteristics, relations with customers to modify certain peak loads, and many, many other detailed activities. But as important as any perhaps, is prudent modernization.

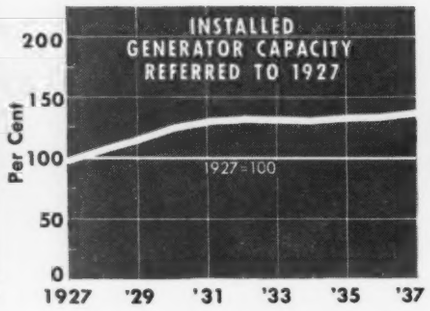
CONTRIBUTING to prudent modernization is co-operation between the manufacturers and the utilities, through new designs, new equipments and new methods, to give the consumer improved service at lower rates. Because the future will continue this trend of supplying more and more for less and less with improved quality, the problem is not one for the utilities to struggle with alone, but concerns the manufacturers as well.

ELECTRICAL WORLD editors present this E.E.I. Convention issue with its theme of Prudent Modernization both as a recognition of the accomplishments of a hard-pressed but courageous, as well as ingenious industry, and also as a pattern of the trend of the near-by future in the necessity to give more service, better service, at lower rates, yet preserving the integrity of the investment withal.

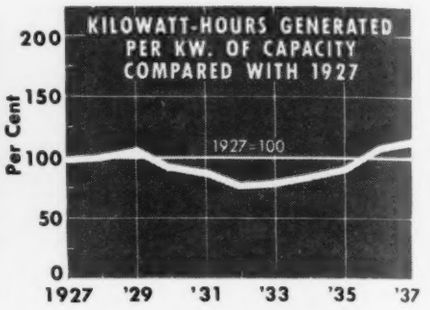
Facts Determine Investment Policies



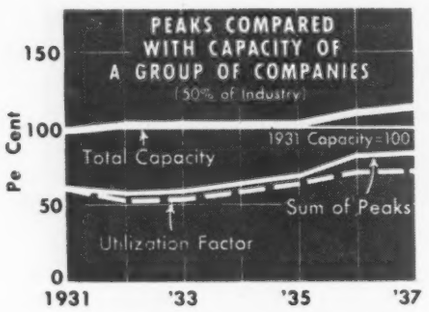
Barring slight interruptions, the trend of energy use is definitely up in every consumer division.



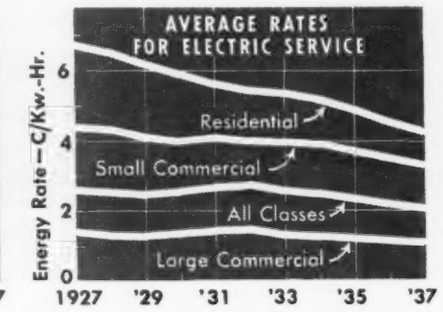
Capacity, on the other hand, was built up for anticipated needs in the period up to 1931 and is now growing only slightly.



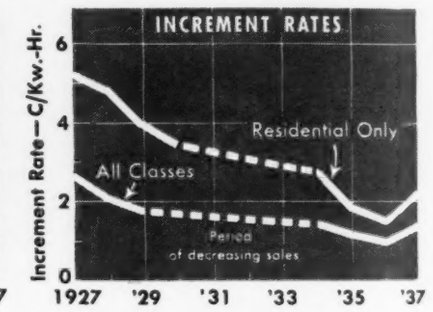
The use of generating capacity is, therefore, at new high levels in terms of output per unit of capacity.



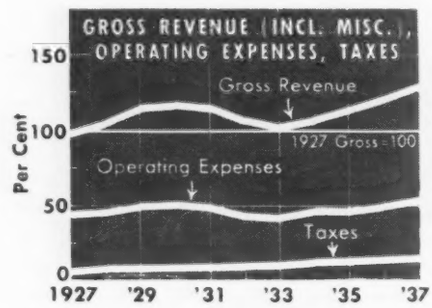
Larger loads have brought higher peaks and greater utilization factors.



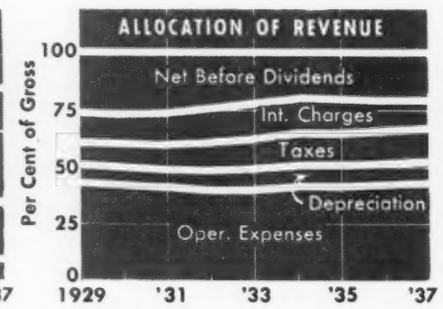
In the meantime, rates for all classes of service have continued to decrease.



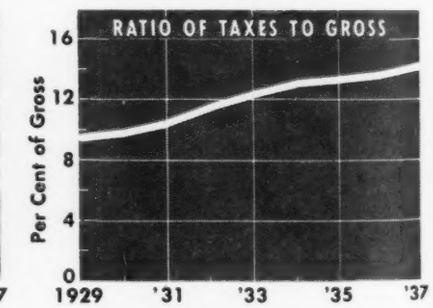
Incremental use brings 2.29 cents (average) for residential and 1.45 cents (average) for all classes.



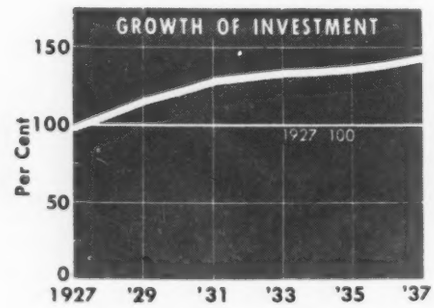
Revenue is increasing, but expenses and taxes are increasing faster.



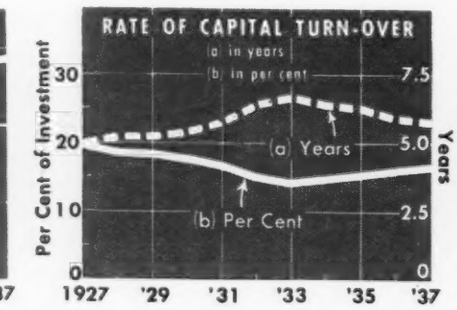
Net before dividends, as a result, is materially less.



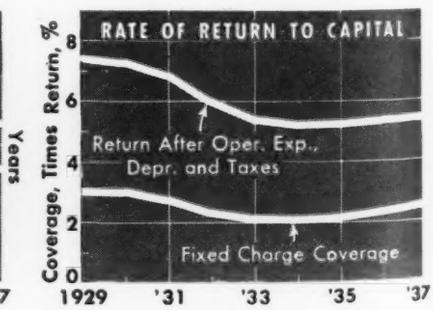
Taxes, one of the worst offenders, show a constantly rising burden.



An increasing investment, nevertheless, is required to meet rising consumer demand.



Capital, however, is now being turned over approximately once in every six years, against every five years a decade ago.



Better fixed charge coverage improves bond position, although capital return now stands at 5.5 per cent.

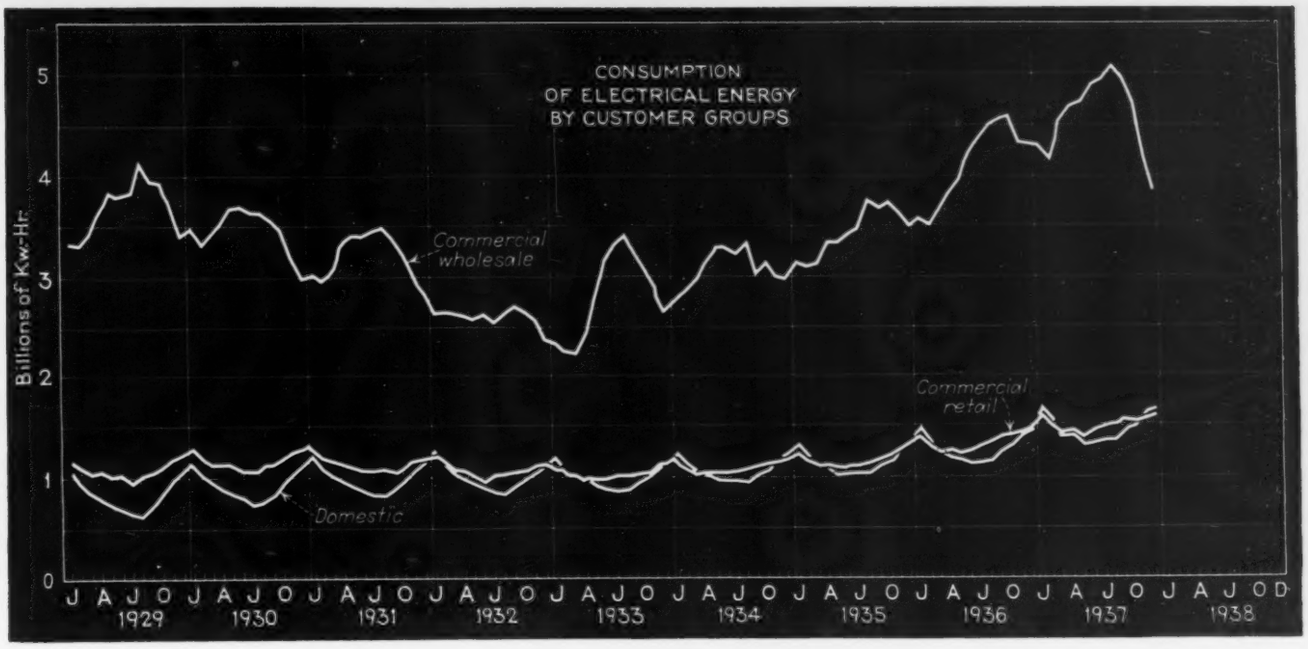


Fig. 1—Monthly Record of Energy Consumption, Classified, Showing Seasonal and Long-Term Trends

The Quality of Load Growth

An Analysis of Load-Building Activities Which Have Brought About the New Demands and New Load Characteristics

OVER the past five years load building has almost been the major activity of electric utilities, first to make surplus capacity that was eating its head off in fixed charges produce some revenue, and then, as peaks once more began to appear, so to select the new load as to create a more efficient use of facilities. It has been the cause and the result of prudent modernization. First it furnished the load that necessitated provision for more capacity, and then, when the modernization was effected, load of the right kind was supplied to make the new expenditure as productive of profit as possible.

Essentially load-building activities can be divided into three classifications: Residential, commercial and industrial. All other loads, if farm use is included with residential, account for less than 10 per cent of the total output.

The relationship of the three basic loads from the standpoint of energy consumption and revenue is shown in Fig. 2. Industrial consumption, which is three times that of each of the two others, brings in but slightly more revenue than the commercial load and only about three-quarters the residential revenue.

From the output curves covering the past several years (Fig. 1) there appears the pattern of load growth which has called for increased facilities. New consumption records appeared in all three categories in both 1936 and 1937.

The residential and commercial loads have shown very little fluctuation and, in fact, the trend seems to show that the large variation between summer and winter consumption is gradually disappearing. The industrial, on the other hand, has shown rather violent fluctuations, due, of course, to the chaotic conditions that have arisen in industrial output during the past ten years.

Long before business or industry generally had recovered to the level of 1929 the electric utilities were experiencing new output peaks. The industrial usage index outstripped the industrial production index as the demand arose for greater mechanization, for reduced spoilage, for better control, for more automatic operation. Commercial customers, of whatever classification, were quick to sense the value of higher lighting intensities, whether for the effect upon sales or upon the employees' work. Residential consumption showed the largest relative gain for the reason that more intensive effort and sales pressure were placed upon that load.

In the development of these loads, however, a new element has arisen that greatly affects any program of modernization, namely, the shifting character of the load seasonally.

Refrigeration, ventilation and air conditioning are filling up the summer valleys, and in many instances, if not establishing new peaks, they are at least beginning to crowd the winter peaks. Many companies are working on methods that will reduce the appliance peak by stretching out the hours of use. Also, it has been noticed that the sales effort that has been placed behind daytime lighting in stores and store windows is helping to fill up what used to be valleys.

One of the effects of the depression was to focus attention upon co-operative sales effort, both with planned market development programs and with

co-operation between utility sales departments and dealers. From both directions came a spurt in load development, especially in residential consumption.

Among the programs are: Better Light-Better Sight, now celebrating its fifth birthday; kitchen modernizing, table appliances, highway safety, running water and adequate wiring. Some of these, of course, stretch over into the commercial field, which also has its commercial cooking program.

Partly because of the co-operation between utilities and dealers and partly because of market development programs the sales of almost all appliances hit new peaks last year. It has been stated that the dealers now account for approximately 85 per cent of the dollar volume of residential appliance sales. With all of these new elements, load has increased faster than it would have otherwise. Even in the larger load-building devices, such as ranges and water heaters, the annual studies which ELECTRICAL WORLD makes indicate a definite trend toward increasing dealer participation in this market.

That more modernization and expansion capacity has not been required has been due to the selective character of the load-building effort. Emphasis has been placed on market research in both the commercial and residential fields. Out of this analysis has come a better appreciation of the low-use and non-profitable customer groups and programs have been set up to improve the consumption position of these groups. There has been a study of load building to secure the best overall condition, such as a correlation of water heaters with ranges.

Much of the load-building program has involved not only more capacity but better voltage regulation, such as for lighting and heating appliances. Last year, for instance, more than four thousand electric ranges were sold in this country.

Hand in hand with load building have gone lower rates and an effort to improve customer relations, both of which have had an effect upon the program of prudent modernization. Lowering rates before earnings had justified a reduction made it essential that load-building activities be speeded up in order quickly to restore earnings. This meant not only regaining enough load to restore the gross, but, in order to restore the net, considerably more to balance the increased expenses of operation and investment. Load building, therefore, became a real serious thing under the pressure of low rates.

While these rates were being reduced, the very people who were responsible for the rate attack were lowering the public confidence in the utilities, with the result that steps had to be taken to improve service—not only electric service but customer contact service through the sales and collections departments. New methods of billing, handling customer accounts and complaints, service requisitions, etc., have been part and parcel of the modern program. The average rates at which each class of customer has been sold have been coming down, and for some time the incremental rate also fell. Last year, however, it rose for the first time, showing the effect of the low-use customer load-building effect. If the incremental rate can be improved, construction can become more attractive to management.

Where load growth tends to get out of balance because of sales activities of others, the trend appears to be for the utility to supply the balancing factor through selective selling. In fact, every indication points to a higher degree of selectivity in utility sales programs today than ever before—selective as to type and characteristics of load, type of customer, locality.

It was load building that brought about the necessity for modernization, but it will be selective load building that will make the modernized station, line or plant profitable.

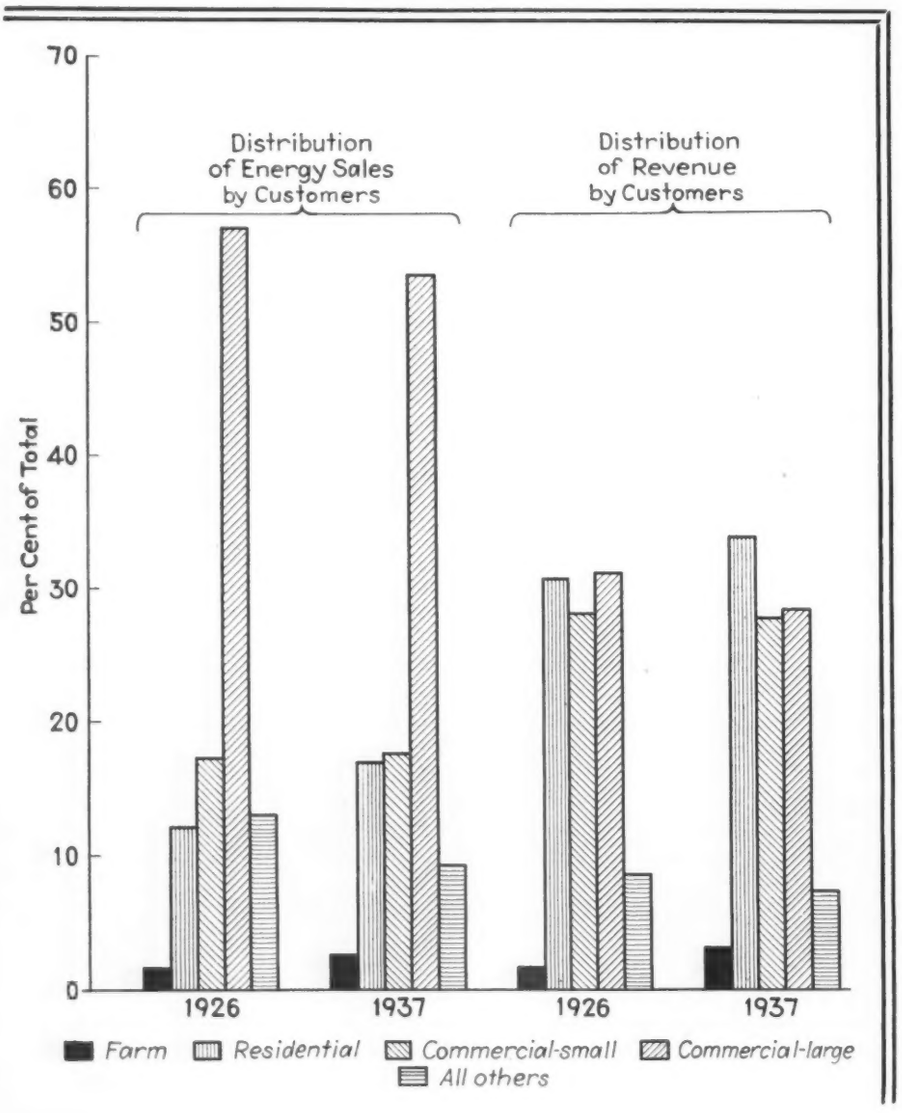


Fig. 2—Relationship of Basic Loads From the Standpoint of Consumption and Revenue

By E. A. HESTER
Superintendent
Systems Planning and Development Department,
Duquesne Light Company, Pittsburgh, Pa.

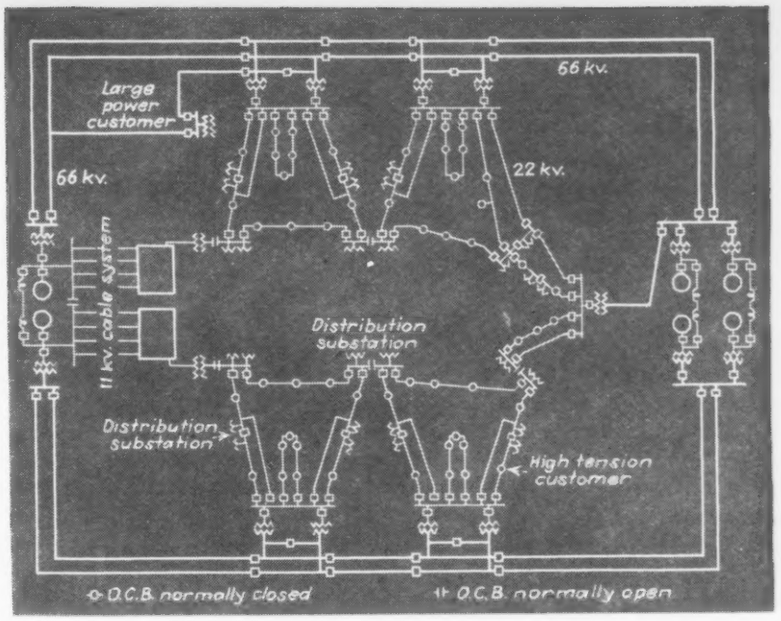


Fig. 1—Basic System Diagram Provides for Power Transfer Between Load Areas

Flexible System Plan Meets Changing System Conditions

EVERY utility has in some form a basic plan for evolution of its system to meet the growing and changing pattern of loads. Originally most of these plans were fairly rigid in conception, but it has been sensed for several years that they would be most useful in conserving investment if they were kept elastic and flexible in their adaptability to unpredictable circumstances. Experience of the past two years has demonstrated more forcefully than ever that flexibility is a prime requirement of any system plan that is to reconcile minimum investment year by year with sustained profitable operations in selling kilowatt-hours.

Several factors have intruded during the recent period to emphasize the necessity for elasticity and adaptability of the fundamental plan of evolution for the system. Some loads have failed to mature when and where they were expected. Others have occurred in unexpected places. Interconnection sources have been altered by the policies of connecting companies. Summer valleys are filling somewhat with various forms of refrigeration and other seasonal loads. There is more disposition to utilize the marginal capacity of lines and equipment. Limitations of condensating water supply and the advantages of superposition, wherever justifiable, have been increasingly realized; these items have also had their effect in the direction of a progressive modification of the basic plan of evolution for the system. These qualifying factors have had their influence on every part of the system from generation to secondaries, and, of course, whatever affects one part has some bearing on the optimum decision for other parts of the system and, therefore, of the plan.

Sales and Planning Co-ordinated

Experience has shown that a flexible plan, based upon fundamental principles carefully worked out, is of greater value than a detailed expansion program projected many years into the future. Ability to meet changing conditions without major alterations is a prime requisite. Of considerable aid in this respect is a close co-ordination between the sales and planning organizations. Practically every system has certain areas in which, at times, excess capacity exists, and other areas which are more nearly fully loaded. A practice which has worked out rather successfully in several utilities is for the planning organization to advise the sales organization where such excess capacity exists, suggesting that sales efforts be concentrated in these particular districts. Meantime, the more fully loaded areas are developed, and by the time the excess capacity in the other areas is used up the newly developed areas become the object of sales effort. By this means a repeating cycle is secured and both organizations know where their efforts should be concentrated.

It is sometimes possible to arrange the system layouts so that the reserve capacity which is normally carried in each area can readily be made available to adjacent areas. In this way the unexpected load can be easily carried until the reinforcing which would normally be necessary has been added. If the system should be divided into load areas, each supplied from the power station or transmission station and covered by a skeleton transmission system with strategically located switching stations, additional load can readily be supplied at almost any point with a minimum of line extensions and station additions. A typical basic system plan of this kind is shown diagrammatically in Fig. 1.

Flexibility an Essential Attribute

The flexibility of the trunk transmission system was illustrated in a particular case with reference to the location of additional generating capacity. Although original plans contemplated a new plant at a certain location, changing load conditions subsequently showed that a different site 30 miles away would be more advantageous. This change was made without adding any transmission capacity or sacrificing any lines already in service.

Due to increasing congestion the cost of transmission will undoubtedly increase, and the time may come when it will be less expensive to build small peak load stations at a relatively high

cost, close to the load center, rather than large low cost stations at some distant point, together with the necessary transmission.

If one could determine where development will occur and how much the load growth will probably be, it would then be an easy matter to plan the system accordingly. But there is always the question of unexpected loads, both as to amount and location, and expected developments which do not materialize. This affects particularly the transmission and distribution systems, which must actually connect to the new and increased customers' loads.

While it may be possible to forecast with reasonable accuracy the growth in residential and small commercial loads, the industrial or large power load, which may form a large portion of the total, is erratic and difficult to forecast. Any plan which may be adopted should take this factor into account and provide the necessary flexibility to handle a wide variety of conditions without disturbing the development of the system as a whole. Hence it is necessary to incorporate into any system plan certain expedients or alternatives to take care of such contingencies.

Equipment Ratings

Every effort must be made to derive the maximum use from each piece of equipment. There are several ways, for instance, of securing an increase in rating of equipment and full advantage should be taken of all of them. A few of these may be mentioned.

Some utility companies now use transformer nameplate rating as the maximum normal load to be carried. Exceptions are sometimes made for emergency or unusual conditions. These nameplate ratings, however, are based on an ambient temperature of 40 deg. C. (104 deg. F.). When the temperature is lower than this figure it is obvious that the transformer can carry more than nameplate rating. There are other factors, such as daily variation of load, which will permit most transformers to be loaded considerably higher without exceeding the permissible copper temperature. A thorough study of local conditions, transformer characteristics and character of load will undoubtedly result in some increase in permissible loading of transformers, thereby permitting the carrying of unexpected loads or loads of uncertain duration without additional capital investment.

In the event such practice is adopted, the proposed A.S.A. guides for operation contain very complete rules for transformers with and without winding temperature indicators. For transformers without such indicators the rule permits a continuous overload of 1 per cent for every degree C. that the ambient temperature is below 30 deg. C., and even greater loads for the normal recurrent short-time peaks usually experienced. Thus, in localities where temperatures are 15 deg. C. or lower a blanket increase of 15 per cent could be made in the normal rating of all transformers for continuous loads and as high as 30 per cent for normal load cycles, depending on the load characteristics.

Beyond these A.S.A. increases for normal recurrent loads there is also the possibility of carrying even greater emergency overloads which can be used in planning for increased capacity. For instance, if cables are not fully loaded prior to the time the emergency arises, considerable time-lag is inherent and will permit carrying a greater load for a few hours without exceeding the permissible copper temperature. Furthermore, it frequently happens that the emergency arises by reason of one or more of the cables in the same subway being out of service. In this case the rating can be increased due to the reduced number of the loaded cables.

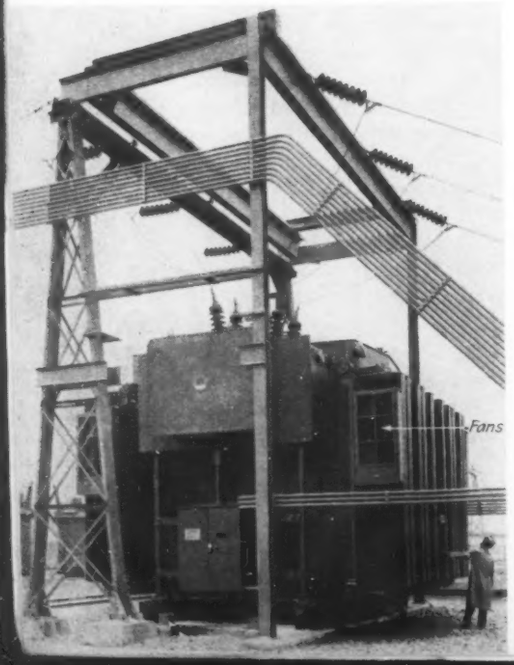


Fig. 2—Added Air-Blast Cooling Is Often Simple and Materially Enhances the Flexibility of the System Plan—A Large Regulating Transformer of This Type Is in Itself an Addition to Flexibility of Operation

Another important factor is the ambient earth temperature. When this is below the assumed value of 20 deg. C. a correspondingly higher load can be carried safely.

Overheating Limits Life

These normal emergency carrying capacities have been set up on the basis that the recognized safe operating temperature of the conductor and insulation would not be exceeded. Serious consideration, however, should be given to the economy of accepting in rare instances a higher operating temperature for a brief period than is recommended for normal operation. In the case of transformers and paper-insulated cables this higher temperature would decrease the life by an amount depending on the maximum temperature and duration of the overheating. The general relation as determined by research is that deterioration doubles for each 8 deg. C. In the case of cables it can be shown that an overload of 50 per cent, resulting in a maximum copper temperature of 120 deg. C. and occurring twice every year, once in the winter and once in the summer, would reduce the life only 4 per cent. This example is introduced only for the purpose of illustrating that occasional real overloads are not serious, and to suggest that the greatest economy may be obtained by accepting infrequent overloads under unusual conditions.

It is the usual practice to adopt a very limited number of circuit ratings corresponding to certain standard conductor sizes. Where cable is involved, a safe current-carrying capacity depends on a number of variables, such as the number and loading of other cables in the same subway. The result is that the standard rating must be set to accommodate the worst condition of any one cable, while all other cables are underrated. Consequently, a very marked increase in capacity can be realized by rating each circuit according to its own characteristics.

Further increase in capacity can be obtained by eliminating the weakest link in each circuit. This link is usually a current transformer, disconnect, cable entrance, or something similar, and can be reinforced at very small cost.

In some cases where unexpected loads occur it is possible to obtain an appreciable amount of extra capacity by the installation of air-blast cooling on transformers (Fig. 2). Also, it may be possible to supplement existing substations with portable substation units.

including transformers, circuit breakers, lightning arresters, and so on, which can be easily moved from location to location. There may be instances where the uncertainty of the load may not justify the cost of installing extensive duct systems, in which case it is feasible to resort to buried cables, thereby reducing the initial investment.

Running spare capacity equal to the size of the largest unit on the system has proved sufficient in the past. Whether or not the running spare capacity should be increased in the future depends to a certain extent on the number of units operating and, of course, the size of the largest unit. The element of probability enters to the extent that theoretically the running spare capacity should increase with an increase in the number of units operating, because with a large number of units there is a greater probability of two units breaking down at the same time than with a smaller number of units. However, any necessary increase in the running spare capacity due to this factor may possibly be offset by improvements in the reliability of new and old units.

Running spare capacity may be made up entirely of generating capacity on the system, or of some generating capacity together with capacity which can be relied upon from interconnections with neighboring utilities and possibly from the overload capacity of units.

Superposition Limitations

The use of high-pressure superposed equipment in conjunction with older plants deserves serious consideration. This is partly because in many cases old boilers may need replacement, while the turbines are still good for many years' service. High-pressure equipment in such a case provides a means of obtaining additional generating capacity at an attractive figure as compared with a complete new unit. Also, a combination unit of high- and low-pressure turbines has very good fuel economy.

Most utilities require a certain amount of capacity to carry peak loads a few hours a day during certain seasons of the year. The small turbines are ideal for peak-load service. The warming up cycle of high-pressure units is rather long for use as peak-load capacity. However, if only a sufficient amount of high-pressure boiler and turbine capacity were installed to supply steam for base-load operation and low-pressure boilers were installed to supply the remaining turbines of the station for peak-load operation quite a desirable combination results.

Should turbines be "topped," then they, together with the high-pressure units, must be used for base-load operation because of the problem of stopping and starting. It becomes necessary then to use the large and less flexible units for peak-load service.

Superposition may result in a large combination unit which might increase the running spare requirement. On the other hand, it adds to the flexibility of the system plan in that it provides a means of adding capacity in locations that may otherwise be restricted. It also may add to the number of locations from which a choice may be made.

Seasonal Load Variation

Reserve may be defined as the amount of capacity which is added to the estimated peak loads in determining the total required generator capacity and is to provide for breakdowns of capacity while in operation and for errors in load forecasting.

Most utilities experience their high loads in the winter time. If the difference between the summer and winter load is equal to or greater than the size of the largest unit on the system, then the required amount of generating capacity is determined by the winter peak load plus the estimated amount of reserve capacity. If the summer dip in load is less than the size of the largest unit, then the required amount of generating capacity is determined by the summer peak load plus the estimated amount of reserve and less the reduction in capacity during the summer and less the size of the largest unit taken out of service for inspection and overhaul.

Recent studies have revealed that this difference between winter and summer loads has decreased quite appreciably during later years, due in most part to air conditioning, refrigeration and other seasonal loads. The net result will undoubtedly be that generating capacity additions appear to be necessary at an earlier date in the future, due to the requirements for inspection and overhaul of units. However, it should be remembered that where capacity is required because of the summer condition, a shortage may not be as serious as it would appear. In such a case advantage may be taken of the postponement of maintenance of the units.

Plan Co-ordinates Steam and Hydro

By A. H. MARKWART

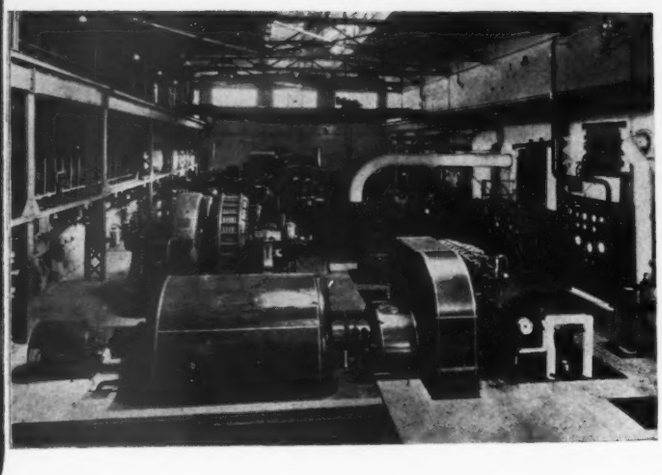
Vice-President in Charge of Engineering,
Pacific Gas & Electric Company,
San Francisco, Calif.

IN THE matter of system evolution, co-ordination and interconnection the Pacific Gas & Electric Company has been favored by its relatively large territory, a good diversity of demand and both water power and natural gas as energy sources. As a result the basic pattern for system evolution with increasing load has for many years been the most economical apportionment of new capacity between hydro and steam, consistent with dry season and dry year security. This basic program will undoubtedly be followed for the future.

With reference to generating facilities, the present construction program includes the installation in an existing plant of one 50,000-kw. turbo-generator unit nearing completion, the construction of two new 50,000-kw. steam-electric plants about to be started in the field and a third new plant of like size programmed to start in 1939. Early consideration will be given to hydro, with construction proceeding more or less concurrently with the closing of the steam program.

Interconnections of ample capacity have long existed among the major Pacific Coast companies, although the interchange of power has, in practice, been limited to rather small surpluses moving north and south.

With respect to additional generating facilities, load growth and, to some extent, replacement of obsolete plant are the criteria for expansion. There is no retardation of program by limited capital, current desirabilities are being fully met, and there are no bottlenecks to be eliminated.



Front View of 320,000 Lb.-per-Hour, 875-Lb. Pressure Boiler Unit Recently Installed in Neches Station of Gulf States Utilities Company at Beaumont, Tex. (left)

7,500-Kw. Superposed Turbine - Generator Unit Recently Installed in Turbine Room of West Jackson Street Station of Tampa Electric Company (right)

Power Plant Renovation and Expansion

By FRANK S. CLARK

Consulting Engineer
Stone & Webster Engineering Corporation,
Boston, Mass.

Certainty of Future Load Increases Stimulates Economic Analysis of Development Programs —Over-all Results Determine Design Trends

FORESEEING a period of increasing industrial activity three years ago, the public utility industry began to make provision to handle increases in load resulting from this revival. Orders for power plant equipment were placed in increasing volume. The number of steam turbo-generators ordered, their types and capacities, aggregated 647,500 kw. in 1936 and 1,817,950 kw. in 1937. The capacities of these units and ratio of superposed to condensing machines is given in Table I.

The reversal of the trend toward superposition indicated above is natural. Loads were increasing more rapidly; the industry had regained and surpassed the 1929 and 1930 peaks, and had need for all its steam and electric generating capacity. The advantages of superposition had been largely realized. Moreover, condensing turbines can be added in as short a time as superposed units, besides being somewhat more efficient than the latter. They result in greater additions to capacity per pound of steam generation. Most, if not all, of the units ordered in 1936 are now in regular or preliminary operation. The 1937 units are in process of manufacture or erection.

The decline in industrial activity which set in last fall has given pause to this active preparation for the future, but it is gratifying that cancellations of turbine orders have been negligible and postponents relatively few. With favorable business prospects and improved financial conditions the industry's forward march will undoubtedly be resumed.

Table II shows the trend in pressures and temperatures in connection with the more recent units on order. The preference is now for the 800-900-lb. pressure range. The greatest number of 1,200-1,290-lb. superposed units is due probably to steam conditions in the plants where the units are installed and to the desire to realize the maximum benefits from the installation. Temperatures selected are governed somewhat by pressure. The preponderance indicated is in the 900-950 deg. range, which is considered the maximum desirable with existing materials. We may expect higher temperatures (1) when present materials have shown themselves capable of withstanding temperatures up to 950 deg., (2) as new materials are developed and (3) when higher temperatures are shown to be economically justified.

Higher Speeds and Hydrogen Cooling

Turbine makers have lately introduced tandam-compound condensing units rotating at 3,600 r.p.m., the low-pressure elements being of the double-flow type. The limit to attainable capacity is the length of the last rows of blades. This is now about 50,000 kw. Generator limitations would allow a capacity of about 75,000 kw., and these ratings are obtainable in superposed units. These capacities are at 80 per cent power factor.

Employment of hydrogen as a cooling medium for generators, particularly at 3,600 r.p.m., is becoming general. Twenty-six such generators are now in operation or on order, and all but three are designed for the above speed. Efficiency gains range from about 0.5 per cent at full load to 3 or 4 per cent at ¼ load.

Steam Generating Equipment

In the modern steam generator the portion of convection heat-absorbing surface formerly known as the boiler comprises a relatively small proportion of the total area and absorbs only a small percentage of the heat. In three typical installations the percentages of heat absorbed by the boilers were 13, 8 and 15.3, the steam pressures ranging between 1,275 and 1,425 lb. and steam generating capacities of the units from 412,500 to 1,000,000 lb. per hour. It is of interest that the water walls absorbed from 45.5 to 55.4 per cent of the liberated heat. Superheaters absorbed roughly two to three times the heat ab-

sorbed by the boilers and in two of the units the economizers absorbed more than the boilers. These figures mark a decided trend in steam generator design toward higher efficiencies in comparison with earlier boiler installations. Use of higher temperatures has increased the size of the superheater and its proportion of heat absorption. High rates of steam generation, however, have increased circulation problems, and these have not as yet been completely solved. On the whole, however, recent advances in the art of boiler and turbine design have contributed materially to the control of investment costs, and this is a most important point in the utility industry's picture in view of the necessity for getting the utmost out of each capital dollar consistent with reliable service to customers.

Table I—Steam Turbo-Units Ordered in 1936-37

	1936			1937		
	Superposed	Condensing	Total	Superposed	Condensing	Total
Units	14	7	21	11	43	54
Capacities, kw.	197,500	450,000	647,500	293,000	1,524,950	1,817,950
Percentage of						
No. of units	67	33		20	80	
Capacity	30.5	69.5		16	84	

Table II—Pressure and Temperature Specifications, Recent Units

	Number of Units		
Pressures	Superposed	Condensing	Total
lb. per Sq. In.			
2,400	1	0	1
1,200–1,290	6	5	11
800–900	2	16	18
600–799	2	10	12
Below 600	0	12	12
Temperatures			
900–950	6	11	17
850–899	0	10	10
800–849	4	11	15
Below 800	1	11	12

Superposition Should Not Be a Fad

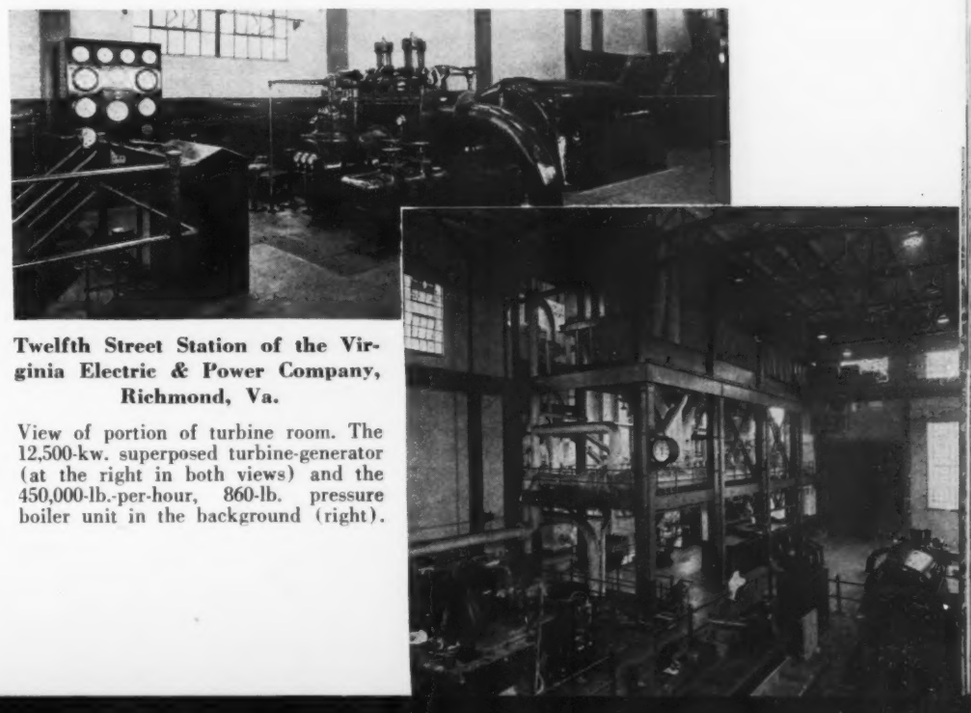
With boiler plant efficiencies now at a maximum range of 85 to 89 per cent it is apparent that the art is close to the economic limits attainable under fuel costs existing or in sight. Further advances in the direction of using higher temperatures and pressures, additional bleeding and further cooling of gases of combustion involve increased costs and difficulties which require much work for successful development. More consideration of load and capacity factors and duration curves is important in analyzing the selection of equipment possessing the higher efficiencies.

Superposition has its uses in increasing capacity and efficiency, besides permitting the retention in active service of older generating equipment. It should not be followed as an engineering fashion, however, since there are other excellent methods of improving efficiency and increasing capacity. Changes in existing equipment, modifications in heat balance and improved handling of interconnected plants all bear upon this objective. In general, plants ten to 25 years old offer the best field for superposition, especially where operating pressures run below 350 lb. and temperatures under 600 deg. Where heat consumptions approximate 14,500 B.t.u. or lower per kilowatt-hour it is increasingly difficult to make out an economic case for superposition. Among the factors involved in such studies are the possibilities of regenerations, methods of driving auxiliaries, changing turbine cross-over pressures, changing furnace designs and combustion methods, age of existing boilers and their condition, efficiency of existing condensers, feedwater supply and operation of combined steam and hydro plant facilities. Growth of load over stated periods must be taken into account, with forecasts of outputs expected from different plants, relation of the plant to load centers, pressure and temperature ranges between old and new equipment. The author discussed certain of these phases of development in ELECTRICAL WORLD, November 23, 1935, and in a paper before the American Society of Mechanical Engineers and Engineering Society of Western Pennsylvania January 15, 1937.

Sale of Steam for Industrial Use

With the advent of high pressures there has been opened to the public utility industry the possibility of generating electrical energy in non-condensing units and the sale of exhaust steam to industries. Although admittedly not of wide application and dependent upon numerous considerations other than the immediate economic advantages, this means of obtaining kilowatt-hours at a low heat rate and realizing a return on the steam sold is receiving increasing consideration from utility executives and engineers. One utility is now building three plants of about 35,000 kw. each to supply steam to three oil companies. In a sense, electricity produced in this way is "by-product" power. On the plant operating side a kilowatt-hour may be delivered to the bus at a rate as low as 4,500 B.t.u., compared with 12,000 B.t.u. in a modern condensing plant, but the capital investment required to meet the particular conditions, the ability of the power company to utilize by-product energy, stability of the industrial demand for steam, local requirements for steam distribution and many other factors must be weighed in determining policies and programs.

Thus we observe growing recognition of the influence of factors outside the specific plant upon engineering programs, no less than the technique of station equipment selection and operation. Opportunities for improving the production of electricity and steam in different combinations of plant and equipment cover a very wide range of interest and promise the engineer worth-while occupation for many years.



Twelfth Street Station of the Virginia Electric & Power Company, Richmond, Va.

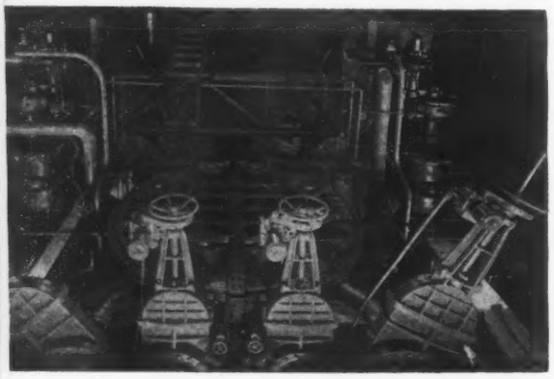
View of portion of turbine room. The 12,500-kw. superposed turbine-generator (at the right in both views) and the 450,000-lb.-per-hour, 860-lb. pressure boiler unit in the background (right).

Buying a Two-Furnace Boiler and Salvaging a Turbine From an Idle Power House Protected Service and Increased Capacity at Oil City, Pa. (above)

Controllable superheat, 100,000 lb. per hour, 84% efficiency. New surface condenser, modernized feedwater treatment.

Replacing Jet With Surface Condenser and Reblading Turbines for 25% Increased Output First Steps in Program of Doubling Capacity and Increasing Economy (below)

Mine-Mouth plant at Seward, Pa. Turbine foundations reinforced. Two new 675-lb. 825 deg. water-cooled stoker-fired boilers of 200,000-lb. each installed in space planned for units half this size. New high-pressure boilers will serve old turbines through reducing valves, until a new high-pressure hydrogen-cooled turbo-generator is installed at Seward.



PRUDENT MODERNIZATION

NEEDED CAPACITY ATTAINED WITH ECONOMY

By J. A. POWELL

Vice-President E. M. Gilbert Engineering Company, Reading, Pa.

When additions are made to old stations they usually carry with them such 1938 benefits as feedwater treatment, coal handling, dust removal and condensers, as well as increasing the rating of old prime movers.

In the last three years this firm designed and supervised the erection or reconstruction of a number of steam boiler and turbine installations, ranging from 5,000 kw. to 35,000 kw. In addition to the typical jobs shown, new coal-handling equipment sufficient to serve the old and new boiler plants as well as a future 7,500-kw. extension was installed at the Alexandria plant of Virginia Public Service. This was in conjunction with a new 5,000-kw. turbine, stoker-fired boilers and an electrical precipitator eliminating stack dust from old and new furnaces.

West Reading plant of the Metropolitan Edison Company has a 30,000-kw. turbine at 250 lb. pressure, 600 deg. F. with surface condenser and necessary boilers, also 39,000 kw. of electric generating equipment at 200 lb. pressure and 500 deg. F., with jet condensers supplied by a boiler plant whose age had caused its capacity to be derated to 20,000 kw.

First step for the superimposed plant extension was to recondition a 20,000-kw., 200-lb. pressure generating unit to operate on 250 lb. pressure, 600 deg. F. The turbine was renozzled for more efficient operation on light load and its rating increased at 250 lb. pressure from 20,000 kw. to 25,000 kw. The generator had been rewound for 25,000 kw. following a recent insulation failure. This established 250 lb. as the pressure of the 30,000-kw. and 25,000-kw. low-pressure generating units, which ultimately will normally operate in conjunction with the 20,000-kw. topping turbo-generator.

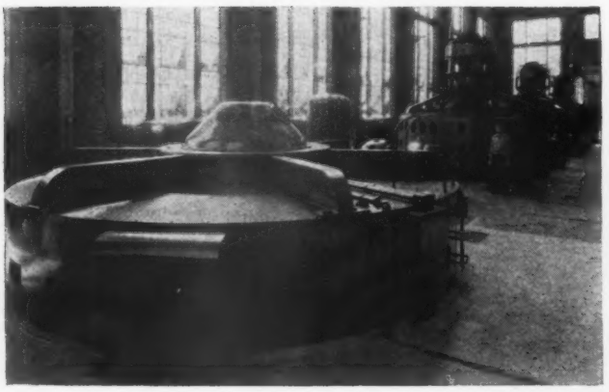
Second step was to substitute a surface for a jet condenser on the reconditioned newly rated 25,000 kw. turbo-generator This has eliminated the need of a complicated and costly water-treating system to protect the high-pressure boilers and will increase the efficiency and reliability of all steam-driven equipment comprised in the new cycle.

Third step would be to install new equipment to treat the water for the new boilers and replace the antiquated water-treating system belonging to the old boiler plant.

Fourth step of the program would be the construction of a separate building to house two 275,000-lb.-per-hour boilers, designed for 1400 lb. pressure at 900 deg. F., and one 20,000-kw. superimposed turbine and accessories. This building would abut the old station at a location adjacent to the above-mentioned two low-pressure turbo-generators that would operate in conjunction with the proposed topping turbine. This would centralize the equipment and personnel during normal operation of the plant.

The first and second steps have been completed and the benefits already realized. Boilers, turbine and other equipment for the completion of this program have been in the process of manufacture, but are held up temporarily until conditions are more favorable.

QUARTER MORE CAPACITY IN SAME SPACE



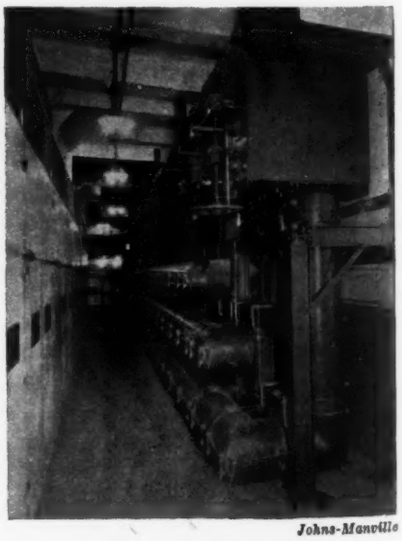
Stevenson hydro-electric station's new 8,000-kw. generating unit on the Connecticut Light & Power Company system gives 28 per cent greater capacity than that of the unit for which the wheel pit was originally designed with an added slight gain in overall efficiency. Of the four units installed, this one (foreground) is most favored for frequent operation.

Worthington Pump & Machinery Corp.

DEAERATING FEEDWATER HEATER

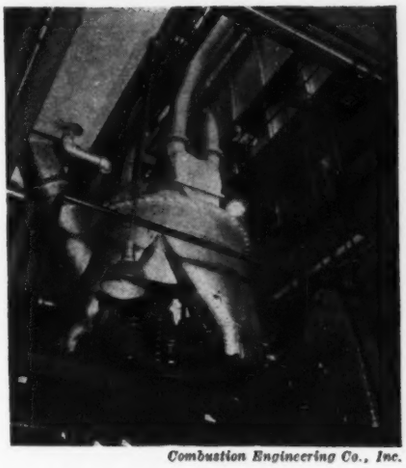
This 750,000-lb. horizontal storage type deaerating feedwater heater is installed at Miller's Ford power station of the Dayton Power & Light Company, Dayton, Ohio.

REACTORS HOUSED OPPOSITE BUS



Johns-Manville

Trancell compartments house reactors opposite R. & I. E. inclosed buses in the Waterside station of New York Edison Company.



Combustion Engineering Co., Inc.

BOWL MILL FOR H.P. BOILER

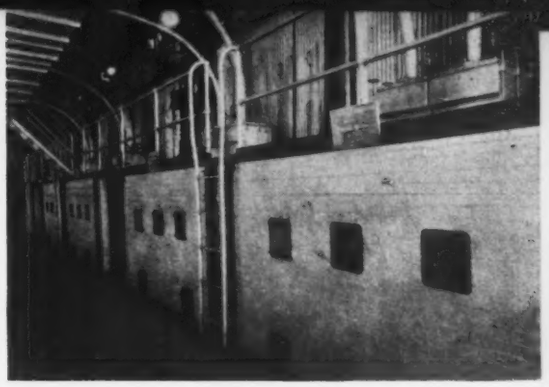
Bowl mill serves high-pressure boiler at Twelfth Street station of the Virginia Electric & Power Company at Richmond, Va.

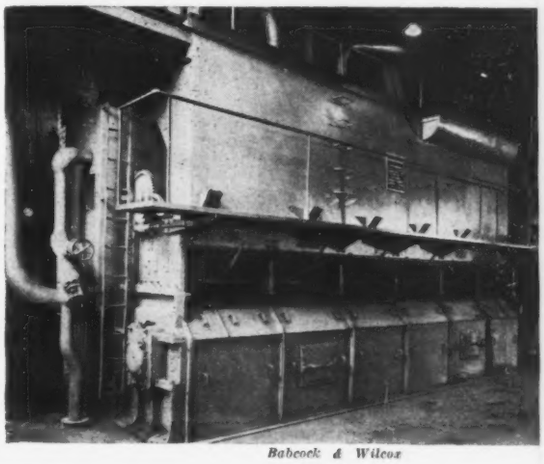
EXPANDED BOILERS AND TURBINE SERVE GROWING STEAM HEAT LOAD

Load growth in both the heating and electric utilities of the Milwaukee Electric Railway & Light Company necessitated making provisions for extensions to its generating facilities. Because one of the steam generating stations has six small boilers which have been in service for 38 years and were in need of major repairs, this station, East Wells Street (formerly called Oneida Street), was chosen for the installation of new boiler capacity in an addition to the structure. The installation consists of one 725-lb., 825-deg. boiler and a 13,700-kw. back-pressure turbo-generator capable of supplying 168,000 lb. per hour to the heating mains at 20 lb. pressure. The old boilers sent only 102,000 lb. per hour to the heating utility. The (1917) original pulverized fuel experiments were conducted on them. The larger capacity of the new installation will serve to take care of steam load growth.

A heat exchanger will be installed which can be used as a condenser, thereby permitting full load to be carried on the turbine at any time, irrespective of heating demand. The electrical capacity of the generator thus becomes firm.

Not only will the new unit effect a substantial saving because of its improved boiler efficiency, maintenance, and other operating costs, but also because of its being able to produce electrical energy from base-load steam before the steam is passed to the heating system.

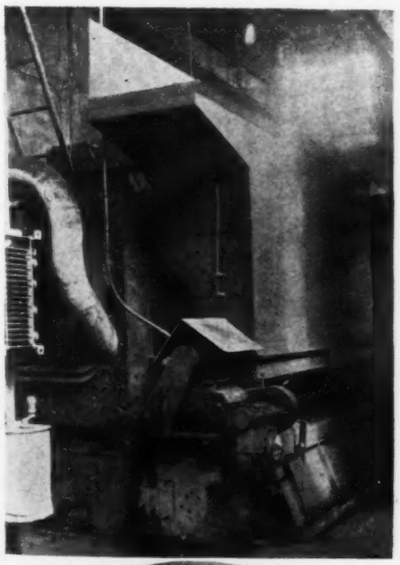




Babcock & Wilcox

HEAVY-DUTY CHAIN GRATE STOKER

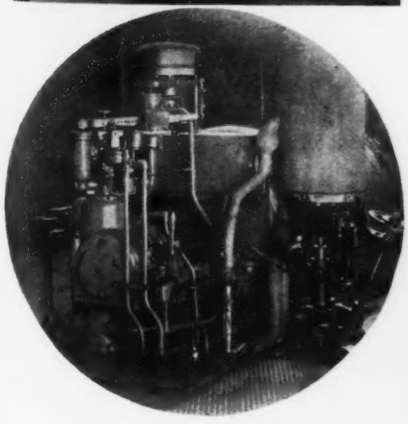
Heavy-duty, forced-draft chain grate stoker, arranged for bottom air admission, installed at Dresser Power station of the Public Service Company of Indiana at Terre Haute. Sargent & Lundy were the consulting engineers.



IOWA SYSTEM ADDS STEAM AND POWER CAPACITY

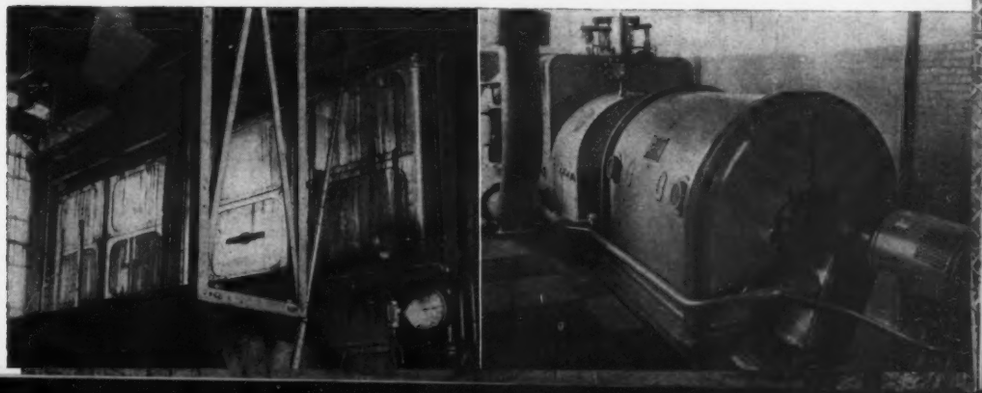
At Cedar Rapids, Iowa, a by-product power turbine for operation in connection with the central steam heating system was installed; maximum throttle flow of 250,000 lb. of steam per hour; steam extracted at 100 lb. gauge for an adjacent industrial plant as well as to supply feedwater heating; expanded to 5 to 15 lb. gauge for the central steam heating system supplying the business district.

In addition to the steam heat turbine there was also installed a boiler rated at 300,000 lb. of steam per hour at an operating pressure of 750 lb. with a total temperature of 750 deg. This boiler is equipped with superheater, economizer and air preheaters and is fired by a water-cooled underfeed stoker. Steam from this boiler passes through a by-product power turbine rated at 5,000 kw. which exhausts into the old station header at an exhaust pressure varying from 205 to 215 lb. gauge.



(Left)—At Boone, Iowa, two new Babcock & Wilcox boilers rated 500 hp., equipped with superheaters, force blast chain grate stokers and air preheaters were installed (above), together with a 1,000-kw. by-product power turbine (in circle) for use in connection with the central hot water heating system which serves the business district and some of the residential district at Boone.

(Below)—At Perry, Iowa, a very extensive hot woter heating system is served. Boilers and equipment were old and obsolete. Two new 500-hp. Babcock & Wilcox boilers (left below), operating at a pressure of 235 lb., were installed, equipped with superheaters and natural draft chain grate stokers. A new 1,000-kw. turbine (right), designed for variable vacuum operation supplying central heat system hot water, was installed.



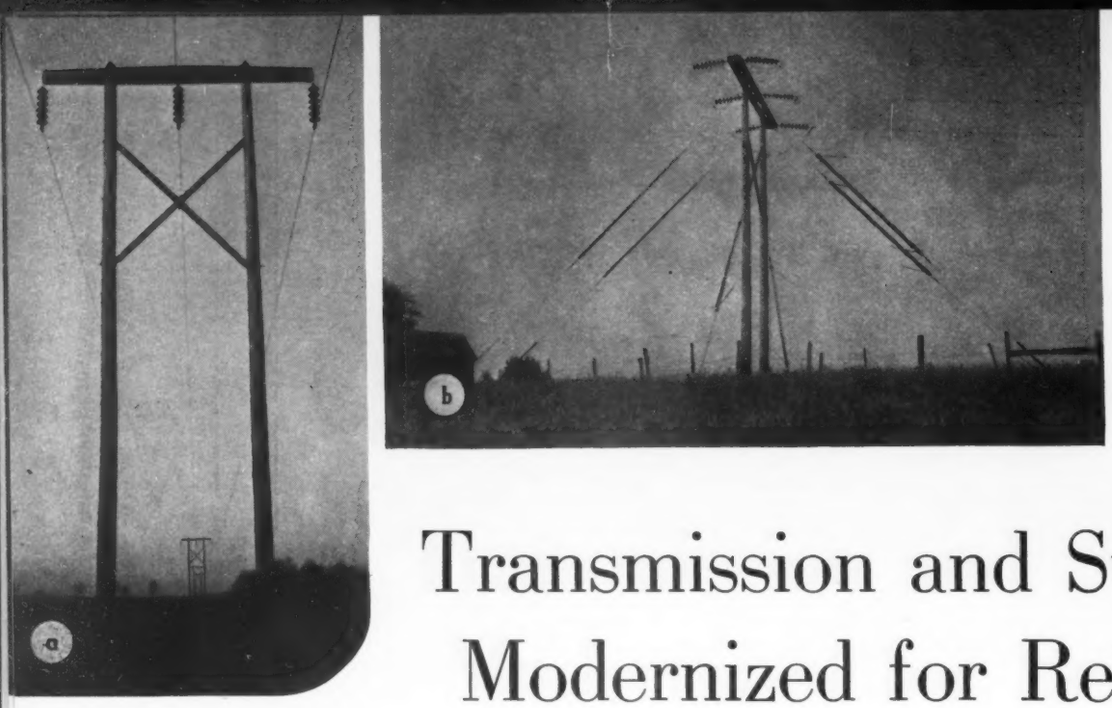


Fig. 1—Wood Throughout Enhances Insulation to Impulses

(a) Tangent structure on 110-kv. line has crossbraces.

(b) Dead-end structure also has wood-strain insulators in guys.

Transmission and Switching Modernized for Reliability

By D. C. STEWART

Assistant Electrical Engineer
Buffalo, Niagara & Eastern Power Corporation, Buffalo, N. Y.

MANY of those now connected with the industry can recall the pioneer days when frequent interruptions to service were expected by operators and accepted by customers as being more or less unavoidable. As the industry developed, improvements in continuity of service were effected. Devices and processes were developed whose effectiveness depended upon a reasonably continuous supply of electricity. The addition of loads of this type served to increase the pressure upon engineers and operators to devise ways and means by which still better service could be furnished to their customers. Notable improvements have been made; more undoubtedly lie ahead. The question is still a dynamic one and will remain so as long as interruptions to service continue.

The desirability of effecting improvements in service and the necessity of accomplishing this at minimum cost are taxing the ingenuity of engineers and operators throughout the industry. Some of the steps taken in recent years by various operating companies of the Niagara-Hudson system are outlined in this article.

Many Transmission Lines Rebuilt

The extensive transmission system, much of which was constructed during the decade of the 1920's and early 1930's, together with the interconnection and integration of the system, has in general been adequate to care for the growth of load in recent years. However, some situations have arisen which required the building of several minimum cost 110-kv. and 60-kv. single-circuit lines. Most of these lines have been built to utilize the insulating value of wood to obtain high-impulse strength in the supporting structures, which are of the H-frame, cross-braced type. Wood insulators are inserted in all guys to preserve the insulation level at guyed points. Fig. 1 shows a tangent structure and Fig. 2 shows a dead-end structure on a 110-kv. line built in the central division north of Syracuse, N. Y.

Early experience with this type of construction in the western division indicated that it is necessary to consider carefully the co-ordinating of substation equipment insulation with the high insulation of the line. Otherwise the substation equipment, even though protected with normal lighting arrester installations, may be subjected to voltages sufficient to cause failure. Continuity of service and protection of substation equipment were satisfactorily insured by the installation of expulsion gaps on all line structures for a distance of approximately ½ mile from each substation. The operating performance of this type of protective equipment has been very satisfactory.

Interconnection into an extensive network comprising more than 3,000 miles of circuits operating at voltages in excess of 60 kv. has effected marked economies in the use of generating capacity and in preserving continuity of service. Nevertheless, interconnection brought serious problems with it. Concentration of power produced heavy short circuit currents beyond the interrupting capacity of existing circuit breakers. A d.c. calculating board was purchased and studies were made to determine possible arangerments of the system which would bring short-circuit curents within permissible limits and at the same time permit satisfactory operation. Investigations of system stability at times of fault were also made. The calculating board has been in practically continuous use for the past few years and has proved itself invaluable.

Interconnection Relaying and Breakers

Technological progress in relaying has been rapid. Development in distance type relays has given the relay engineers an effective instrument for segregation of faulted circuits. This type of relay has been applied extensively. The merits of relaying to protect buses has been recognized, but the expense of installing such protection is great. Its use, except at the largest load centers, has been delayed until more economical schemes are available.

Where studies indicated that no satisfactory arrangement of circuits could be made which would bring the short circuit current within the interrupting capacity of existing circuit breakers, modern arc-interrupting devices were installed in many of the breakers. This made possible faster relaying, reduced the damage at the point of fault and contributed to system stability. Maintenance costs were materially reduced due to lessened contact burning and oil carbonization, less labor per inspec-

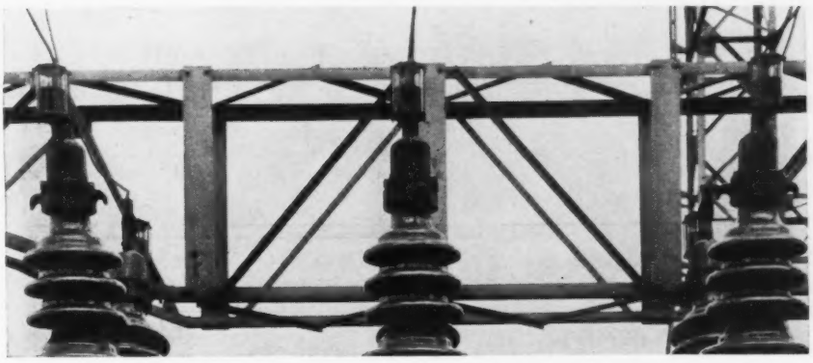


Fig. 2—Oil Conservators Stop Bushing Failures

Patent has been applied for to cover this device. No bushing so equipped has failed in service since installations were made.

tion and increased intervals between inspections.

Prior to 1933 there were a number of bus faults and line interruptions caused by outdoor oil circuit breaker bushing failures. The bushings were the type filled with a solid compound immediately beneath the porcelain rain shield. Analysis of the failures indicated in many cases flashovers on the surface of the solid compound between the compound and the inside of the porcelain rain shields. By installing small, glass oil conservators filled with liquid cable compound, so that the bushing would breathe compound rather than moist air, these faults have been entirely eliminated. Each conservator has a sump which permits visual inspection for accumulation of water in the conservator. Fig. 3 shows an installation of this type of conservator.

Standard co-ordinating gaps set to protect the transformer insulation have been installed in many stations. Older station type lightning arresters have been either replaced or supplemented by modern station type lightning arresters.

Disconnects for Sectionalization

Many sectionalizing points on the 110-kv. and 66-kv. system formerly were equipped with stick operated disconnects mounted on wood pole H-frames. These have been replaced with steel structures using group-operated air-break disconnects. One such installation is shown in Fig. 4.

Transfer buses have been added to some of the older 110-kv., 60-cycle structures. Originally these structures were built with a single sectionalized main bus. This transfer bus facilitates maintenance by allowing two lines to be carried through one oil circuit breaker temporarily. The same bus and disconnects are used to connect lines individually to a large 25-cycle generator separated from the 25-cycle system and used to supply high current for melting sleet from the transmission lines.

Air-blast equipment was not installed on older banks of transformers as there are a large number of water-cooled units, and it has not appeared to be the optimum solution on the few cases investigated. New banks, 2,500 kva. and larger, are either being purchased with air-blast equipment or arranged for its installation in the future.

Automatic oscillographs have been installed at a number of stations. These are normally inoperative, but record current and voltage at times of fault. Quantitative analysis of faults is possible from oscillographic records thus obtained. The oscillograph has been used to effect considerable reductions in costs of line patrols to locate faults. Films are developed as quickly as possible following the occurrence of faults and the information used to determine the approximate location of the fault. It has usually been possible to locate the fault within a few towers, permitting the patrolmen to focus their attention on a limited length of line, thus saving time and expense formerly necessary to patrol the whole line.

A system of periodic inspection and test of high-tension bushings has been instituted and results have been very satisfactory. Bushings are tested by the power-factor method. Before setting up the test program bushing failures were frequent enough to cause concern. The number of such failures is now negligible.

Leased Lines and Carrier

Efficient operation of a power system depends in a large measure upon reliable communication. In the earlier development of the system communication was obtained largely by means of private telephone lines between important stations. These have been largely supplanted by circuits leased from the telephone company and carrier-current communication for remote points. In this area these leased circuits are nearly all in cable and the service has been highly satisfactory. Private communication lines are usually built on right-of-way already occupied by power lines and the problem of "hot" or noisy telephone lines due to inductive interference is a serious one. Leasing lines in this manner has placed our communication problem in the hands of men specially trained in this field.

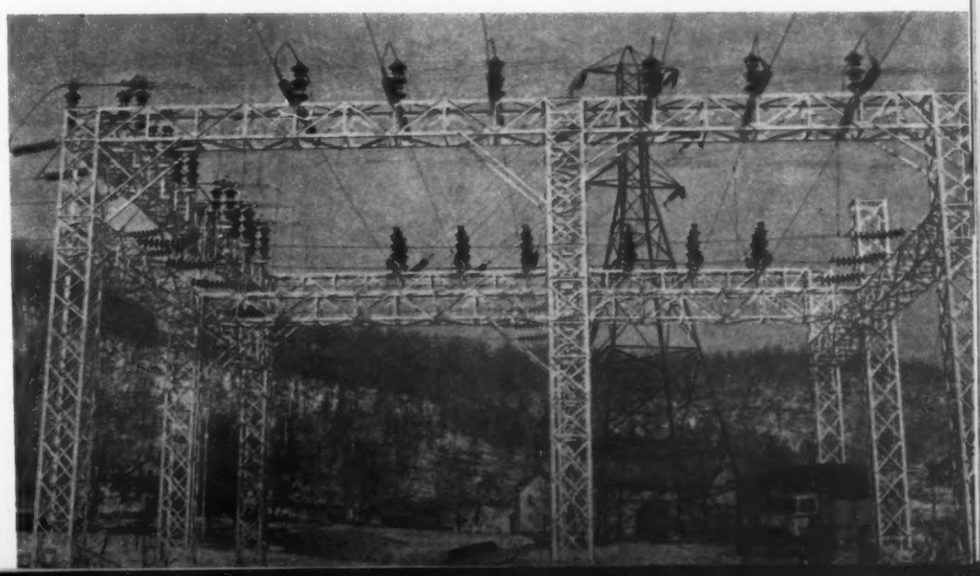
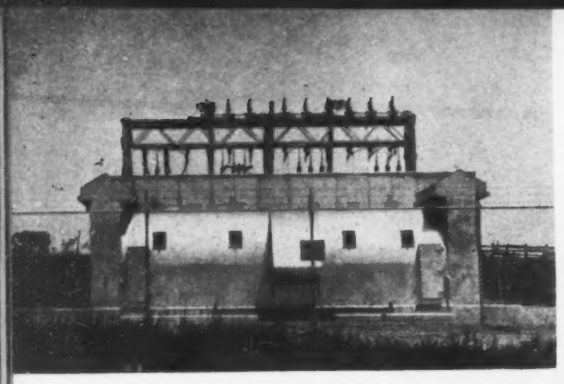


Fig. 3—Steel Erected to Provide for Installation of Gang-Operated Disconnects

This allows sectionalizing to be done by breaking the parallel on live lines (in the case of two lines bussed at each end). With group-operated disconnects the charging current of short sections of single-circuit live line can be taken out while energized (seven miles maximum on 110-kv. 60-cycle line).

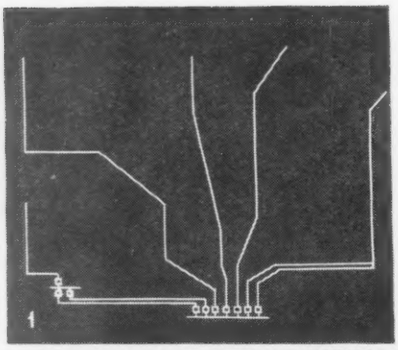


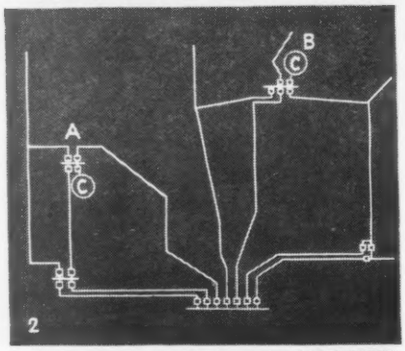
Synchronous Condenser Installation in Switching Station Meets Growing Load Pending Construction of Major Transmission Feeds.

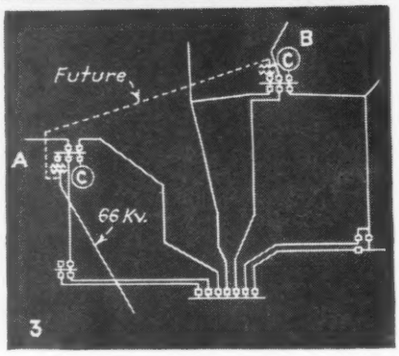
THREE-STEP SYSTEM PLAN MEETS GROWING LOAD

To relieve an impending overloaded condition of a group of 11-kv. radial feeders of the Pennsylvania Power & Light Company system, a three-step program was conceived which called for (1) interconnection of 11-kv. radial feeders near their extreme ends on buses at properly located stations, (2) installation of large, fully automatic synchronous condensers on these tie buses, and (3) the eventual construction of 66-kv. transmission ring and 66,-000-11,000-volt transformer stations tying together these switching stations.

The steps were carried out as shown on the accompanying diagrams. By such a plan it is possible to install the 66-kv. links as they are needed, where they are needed, without overbuilding, and with no compromise with service. Also, transformers serving the residential lighting and other load can now be connected directly to the 11-kv. instead of using intermediate step-down transformers and regulator stations, as previous voltage conditions required.







Progressive System Plan Meets Load Growth Economically

System before change is shown in (1). Two major 11-kv. lines were tied together through oil circuit breakers at (A), three others were tied together at (B) and 5,-000-kva. synchronous condensers were installed on the bus at each of these points as in (2). These steps improved conditions sufficiently to allow leisurely construction of the 66-kv. line to (A) as shown in diagram 3, which forms part of the tie between the two quite widely separated parts of the company's system. The next step in the program will be the interconnection of (A) and (B) with a 66-kv., link, shown dotted in (3). Eventually the transmission ring will be closed with the completion of the 66-kv. lines tying (B) with other adjacent switching stations.

"DUMP" STEAM EXCHANGED FOR "DUMP" HYDRO

By G. G. POST

Vice-President in Charge of Power
Milwaukee Electric Railway & Light Co.

An agreement recently approved by the Wisconsin Public Service Commission between the Milwaukee Electric Railway & Light Company and the Wisconsin Power & Light Company has for its purpose the promotion of the most advantageous coordination of the power production and transmission facilities of the two systems. The former company obtains practically all of its energy from its modern high-pressure steam plants, while the latter depends primarily on its hydro plants as its source of power.

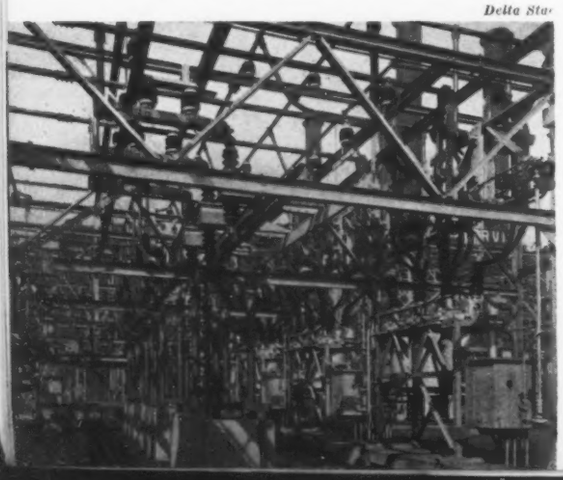
New interconnections at two widely separated points are contemplated and will be established before the end of the year 1938. They will be of suitable capacity for the interchange of 25,000 kw. of energy.

The contract provides that either company may call upon the other for emergency power up to the capacity of established system connections. It also provides for the delivery of "dump" steam energy to Wisconsin Power & Light Company in amounts not to exceed 25,000 kw. This consists of energy which the Milwaukee Electric Railway & Light Company may elect to supply without obligation as to the time of day or the rate, frequency, or duration of delivery. No obligation to install electric generating capacity in order to supply dump steam energy is expressed or implied, and each company agrees to proceed with its own plans for the provision of additional firm capacity to meet the regular requirements of its own system. Another provision of the agreement is the delivery of "dump" hydro electric power by Wisconsin Power & Light Company.

HEAVY-DUTY SWITCHING

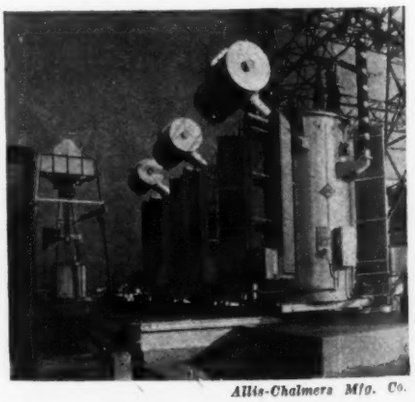
A close-up showing application of heavy-duty switching equipment recently installed in the outdoor substation at the Essex generating station of the Public Service Electric & Gas Company, New Jersey. The group-operated disconnecting switches, rated 3,000 amp., 23 kv., are equipped with special station post insulators with a cantilever strength of 7,000 lb. Gear box mechanisms have electrical interlocks preventing switches opening under load. Connections from disconnects to breakers and buses consist of flexible copper braids, eliminating expansion and contraction stresses. All bus connections are of the clamp type using heavy-duty eight-bolt connectors.

Delta Star



Cable terminators have ventilated type entrances and high-compression cable studs. The 4-in. copper tube bus is rated 3,000 amp. Both gang-operated and stick-operated disconnects, together with all flexible connectors, bus fittings and cable terminators, were furnished by the Delta-Star Electric Company, Chicago, Ill.

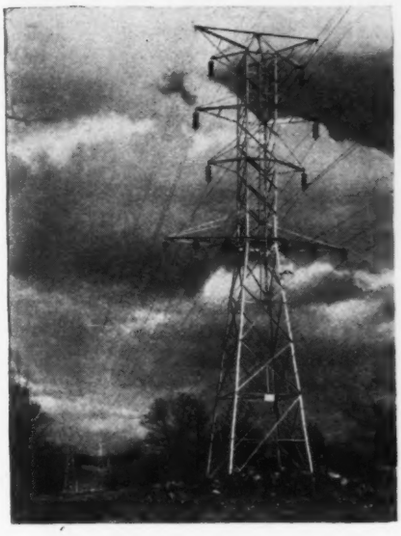
FOUR-WINDING TRANSFORMERS



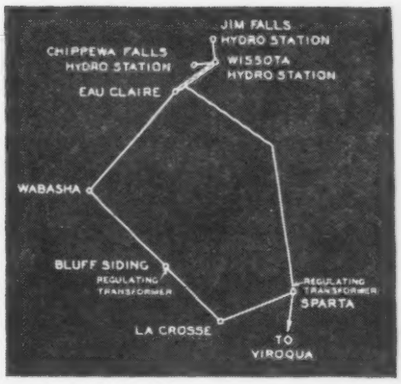
Allis-Chalmers Mfg. Co.

Three single-phase, four-winding transformers installed at Fostoria substation of Ohio Power Company (American Gas & Electric group).

NEW CONNECTICUT TIE-LINE

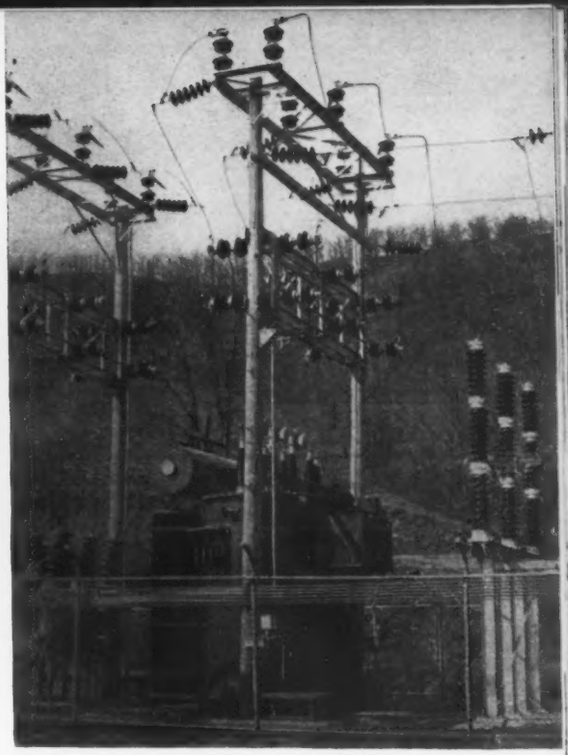


Pooling of generating capacity available to the Connecticut Light & Power and Stamford Gas & Electric company systems is now effective by the completion of a 15-mile, double-circuit, 66-kv. tie line between Stamford and Norwalk. This interconnection also provides an independent power supply for Norwalk, Stamford and southwestern Connecticut generally. A portion of the tower line is utilized to deliver 27.6 kv. energy from Norwalk to the South Norwalk city system over two circuits carried on the bottom arm.



Each Side of Loop Regulated

Thus loads on loop circuit between regulating transformers will be benefited by installations. Generating stations supplying the 66-kv. circuit are hydro stations located at points about 119 miles from La Crosse via short side of loop circuit.



Transformers Regulate 10,000-Kva. Load

Each transformer automatically raises the voltage in steps to a maximum increase of 12½ per cent or lowers the voltage 12½ per cent. Transformer is normally in the 66-kv. circuit, but may be removed from circuit by use of gang-operated by-pass disconnecting switch and line disconnecting switches shown on the two-pole structure.

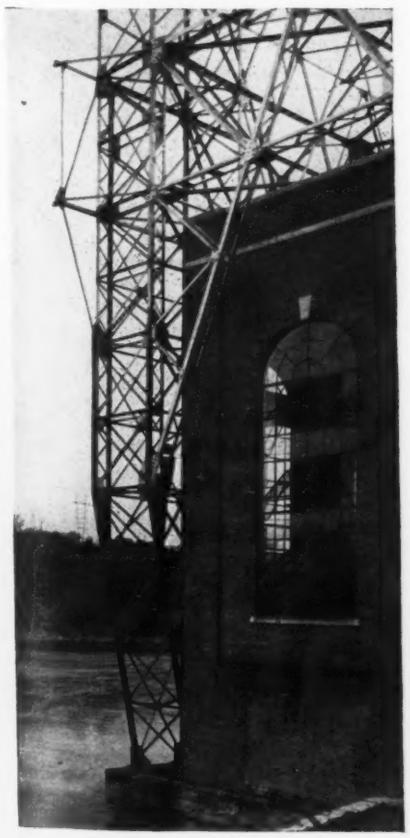
REGULATING TRANSFORMERS ENHANCE LOOP CAPACITY

By B. H. CLINGERMAN
Chief Electrical Engineer
Northern States Power Company,
Minneapolis, Minn.

Completed recently by the Northern States Power Company (Wisconsin) is the installation of a regulating transformer in each side of a 66-kv. loop circuit serving an important load. The load is normally carried by the loop circuit and a generating station of the power company located in La Crosse, Wis., where the load originates. It is planned to erect a new generating station near La Crosse. The carrying out of such a plan will require a large capital expenditure.

Facilities for carrying the load, for a time at least, have been provided by the installation of regulating transformers which increase the amount of load which can be carried by the loop circuit. The installations were predicated upon the conditions arising when a part of the loop circuit is out of service.

One of the two regulating transformers which have been installed to meet the conditions is presented in the illustration above.



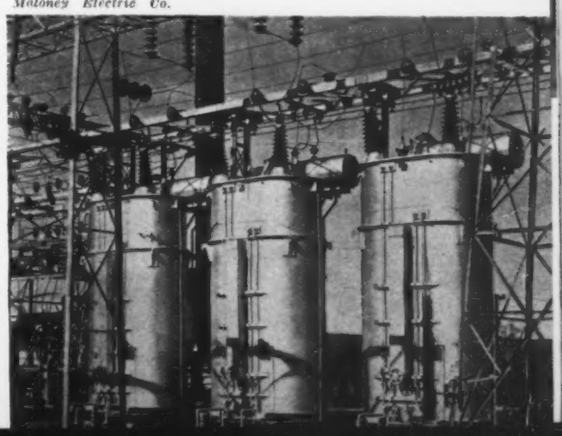
UNIQUE STRUCTURE FOR RIVER CROSSING

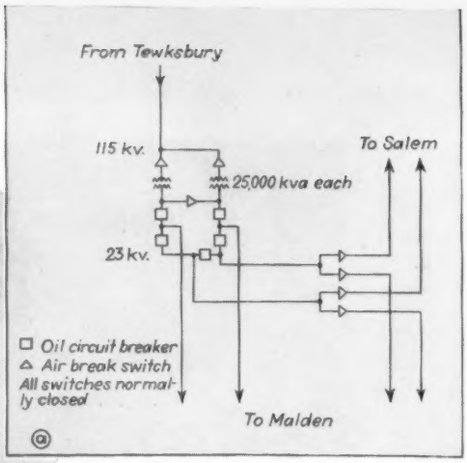
Connecticut River crossing span (1,200 ft.) of new 13.8-kv. tie-line between the generating system of the Holyoke Water Power Company and the Chicopee (Mass.) Municipal Light Department. Power conductors are No. 4/0 hard-drawn copper with two ⅜-in. stranded steel ground wires at top of tower. High water line clearance, minimum, is 40 ft. Pellet type lightning arresters are installed at the Chicopee terminal tower, the rest of the 5-mile tie being in aerial cable. Special steel framing carries the span strain insulators at the Holyoke station, right foreground.

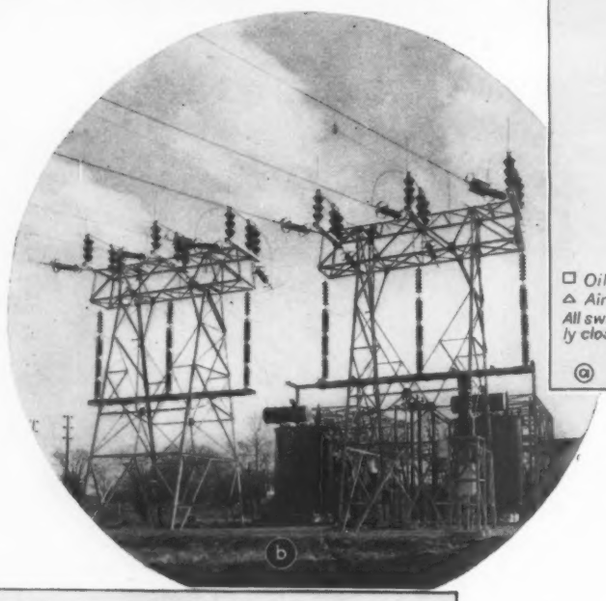
WATER-COOLED 10,000-KVA TRANSFORMERS

Three 10,000 kva. transformers installed last October at Gadsden, Ala., to provide for increased load. Single phase, 60 cycle, water-cooled and rated at 63,500/110,000 Y volts primary to 26,600/46,000 Y volts secondary.

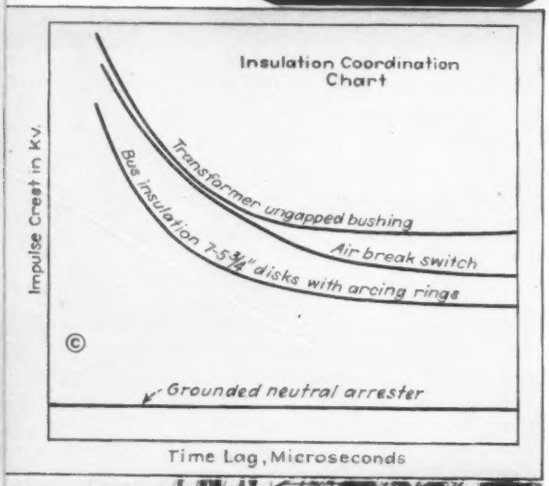
Maloney Electric Co.

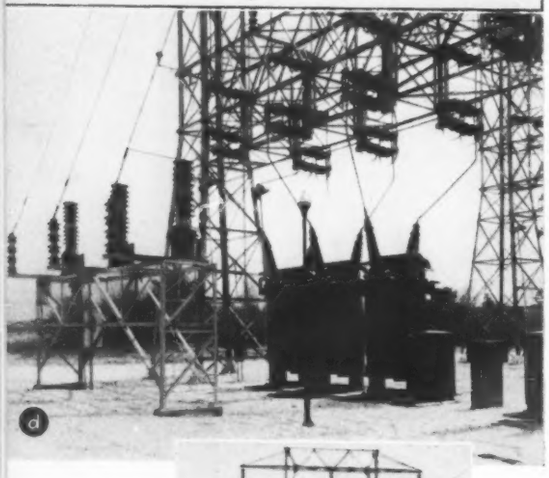


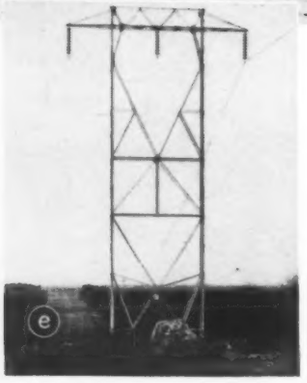




(a) Initial line, breaker and transformer layout at Melrose.
(b) Air breaks, carrier chokes, carrier couplings, lightning arresters and transformers at Melrose.
(c) Insulation co-ordination chart, Melrose station.
(d) Capacitor coupling and carrier equipment outdoors at Tewksbury.
(e) Typical semi-flexible steel tower, Tewksbury - Melrose line.







Some Protective Advances on the New England Power System

Reliability of Transmission Aided by Continuing Engineering Developments — Improved Relaying, Switching and Line Layouts Safeguard Service Over Wide Areas

ELECTRIC transmission requirements on the system of the New England Power Association properties are highly exacting. The major lines embrace over 2,000 miles of steel tower and wooden pole construction carrying circuits of 66-, 110-, and 220-kv. rating. Four of the New England states are traversed in part at least by these lines. The lines form a regional high-tension network tying hydro-electric plants on the Deerfield and Connecticut rivers into steam plants serving urban load centers in the interior and along the coast, with several interconnections with other companies. Many lines of lower voltage function both as transmitting and distributing circuits. Co-ordinated operation has been brought to a high pitch of efficiency through the association and neighboring territory.

The trend of engineering design on the system has long emphasized the

Fig. 1—Recent 66-Kv. Line Embraces Many Modern Features

The Tewksbury-Melrose line provides a direct tie between the lines from the generating plants of the New England Power group which deliver energy to Tewksbury buses and the thickly settled north Boston area, whose loads have been increasing substantially in recent years. From Melrose 23-kv. cables and overhead lines connect with the Malden-Salem and allied local utilities.

It is a single-circuit line of three-phase flat conductor disposition, with 300,000-circ.mil copper power wires carried on 9-8-9 disk insulators suspended from semi-flexible steel towers spaced about 600 ft. apart. The power conductor separation is 14 ft. and there are two 7/16-in. crucible steel ground wires attached to the outer ends of the top chord of the tower framing. The insulators are equipped with grading rings on the conductor end and the average height of the conductors from the ground is 35 ft.

In the initial installation at Melrose two 25,000-kva., three-phase transformers step the voltage down to 23 kv. No oil circuit breaker is provided in the 115-kv. line at Melrose, although air-break switches are installed between the line and the transformers. Oil circuit breakers are provided in the 23-kv. circuits from this substation. At Tewksbury oil breakers are connected between the 115-kv. bus and the outgoing Melrose line.

dual importance of uninterrupted service and the economical handling of steam and hydro plants. These objectives can be traced back a quarter century to the beginnings of transmission from the initial station on the Connecticut River at Vernon, Vt., into the Gardner, Fitchburg and Worcester areas. Expansion of the system has been accompanied by increasing flexibility of layout in lines and plants, including substation and switching installations. In recent years the development of the system has taken further advantage of improvements in relaying, line design, switching layouts, circuit breaker progress, automatic transfer to alternate sources of supply to minimize duration of interruptions, and better lightning protection.

One of the most important lines lately built on the system is a 17.8-mile, 115-kv. circuit (Fig. 1) connecting the New England Power Company's large switching and substation at Tewksbury, Mass., with Melrose in the suburban area north of Boston.

This line, which is designed for a second circuit in the future, contributes to economical operation of all interconnected plants beyond Tewksbury besides postponing steam plant construction at a north Boston tidewater location.

High-speed Carrier Protection

The advantages of high-speed carrier relay protection are illustrated in this line from both operating and investment standpoints. The use of the carrier avoided the necessity of a high-tension breaker at Melrose, since it made possible the transmission of a code signal which would trip the Tewksbury line breakers in the event of a transformer differential relay operation at Melrose. This additional use of the carrier does not interfere with its normal use in connection with the line relaying. The code sending and receiving apparatus resembles supervisory control equipment and the code selected renders false operation on carrier disturbances virtually impossible. If a transformer fault is not cleared instantly at Tewksbury by the line relays it is cleared soon after by the carrier code equipment.

The advantages may be summarized as follows:

(a) The carrier provides instantaneous tripping for faults anywhere on the line, no cascading occurring for end zone faults. (b) During maintenance on the carrier equipment, by throwing a switch the relays are still available as distance relays, making the set-up equal to any previous layout even with the carrier out. (c) The carrier is utilized for tripping the 115-kv. breakers at Tewksbury and the 23-kv. breakers at Melrose when the Melrose transformer differential relays operate (the saving of an additional 115-kv. breaker investment at Melrose considerably exceeds the cost of the carrier relay application). (d) The carrier makes it possible to keep the line from tripping out during out-of-step conditions. (e) Without the carrier the pressure to spend money for an initial two-circuit line would have been much greater, whereas with it rapid fault clearing (10-cycle opening including relay time) is obtained. This would have been unavailable with one line and previous relay facilities at the disposition of the engineering department.

To insure maximum protection against interruptions due to lightning a somewhat novel design (Fig. 2) was applied to a recently completed 7-mile, 66-kv. single-circuit line between Spencer and Charlton, Mass. Known in the system as "Polarm" construction, the major feature is a structure composed of two vertical poles of unequal length and a crossarm made up of a 25-ft. creosoted pole attached by suitable fittings to the vertical poles. The taller vertical pole carries a ground wire with about 18 ft. of wood between it and the power insulators, which are of the suspension type. The wood insulation level is maintained at guy locations by inserting wood guy strain insulators of suitable length to make up any deficiency.

Modernization of a 66-kv., single-circuit line 16 miles long between Barre and Westminster, Mass., is progressing on a step-by-step program, in which a steel wishbone construction (Fig. 3) is being replaced by a wooden crossarm with better conductor configuration. The old 6-ft. triangular spacing of conductors has been superseded by a 5-ft. flat spacing and the spans have been increased from 150 to 300 ft. Formerly the ground wire was centrally mounted at the top of the pole.

In the new arrangement the ground wire is carried at the top of a 3-ft. 6-in. steel bayonet near the end of the crossarm. This gives a satisfactory difference between the height of the ground wire and the plane of the power conductors, for shielding purposes, and the substitution of the wood in the crossarm gives a corresponding improvement in the impulse strength of the insulation.

Ground Wires Below as Well as Above

On a new 7-mile, 44-kv. line recently energized between Bellows Falls, Vt., and Charlestown, N. H., to increase the

Fig. 3 — Barre-Westminster Line, Raised Ground Wire at Left

Fig. 4—Ground Wire Below Crossarms Injects Wood Against Impulses

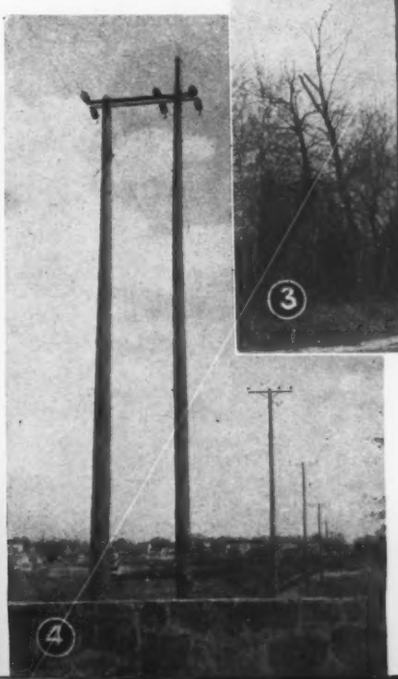
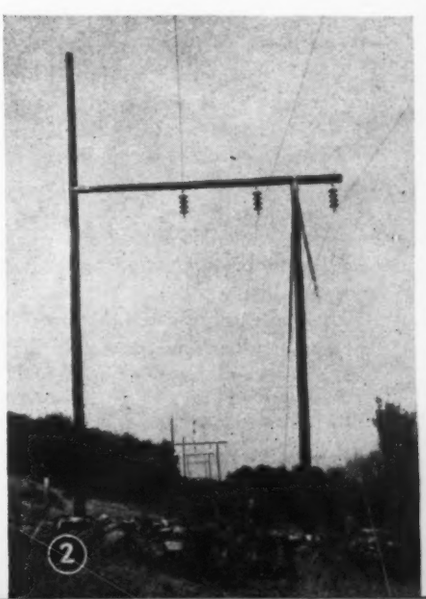


Fig. 2—"Polarm" Construction, Spencer-Charlton 66-Kv. Line, Flexible and Economical

The position of the ground wire tends to divert lightning from the power conductors to ground, and the presence of a continuous ground is an aid to prompt relay operation in case of circuit faults. The structure is lined up in the right of way with the center power conductor in the center of the clearing. The presence of the ground wire near the edge of the clearing affords some degree of protection against falling trees and limbs in wooded sections. The construction is flexible and economical.

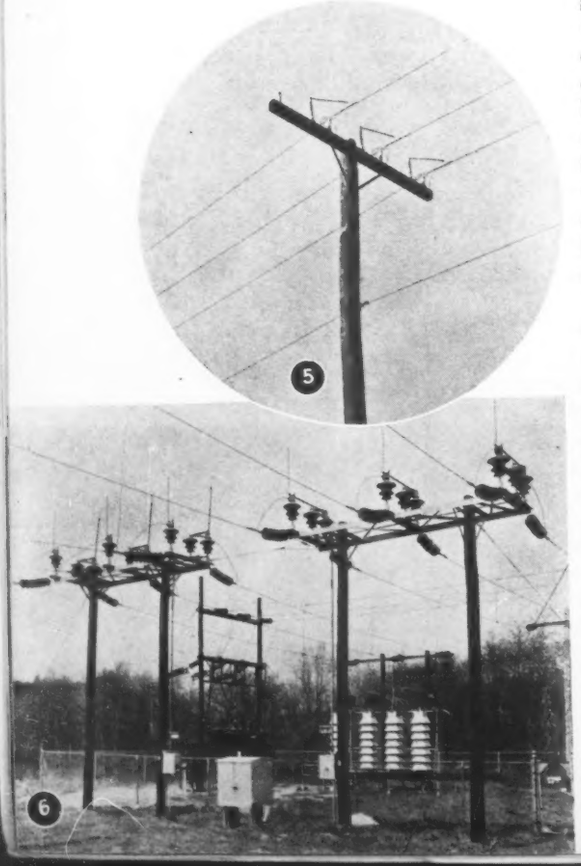


tie capacity between the New England Power Association System and the Central Vermont Public Service system suspension insulators are hung from the wooden crossarm and diagonal braces, with clearances between conductors of 5 and 7 ft. The ground wire is carried above the crossarm by a bayonet of wood, and at a point 4 ft. away from the bayonet a ground lead is tapped off diagonally to the pole. This affords increased protection against lightning on account of the clearance between the ground wire, lead and pole.

Relocation of the ground wire to a point 4 ft. below the crossarm (Fig. 4) has been made on a 22-kv. line in Danvers, Mass. Formerly the ground wire was carried at the top of a steel bayonet extending above the wooden crossarm center, the insulators being mounted for flat spacing. In the new arrangement the bayonet has been removed. Clamping the ground wire to the pole at this distance below the arm provides additional wood insulation against impulses, and the new position of the ground wire does away with short circuits caused by squirrels. If the ground wire breaks no harm is done. Similarly, the ground wire has been relocated on the Northampton-Florence feeder and on a line in Rhode Island between Westerly and Wakefield.

Fig. 5—Expulsion Gaps Relieve Station Arresters

Fig. 6 — Motor-Operated 66-Kv. Air-Break "Flip-Flop" Switches at Spencer



Expulsion Gaps Installed

Expulsion gaps have been installed in four locations in western Massachusetts to provide increased protection (Fig. 5) of substation equipment against lightning surges. In a typical 22-kv. circuit west of Warren three sets of these gaps have been placed in the line distributed along the first 1,000 ft., leaving the substation to act as drainage points and reduce the burden otherwise imposed upon the substation arresters. This tends to prevent damage to arresters by high-voltage surges and by reducing the current discharged by the arrester it cuts down the potential imposed at the transformers.

Recent modernization of lightning arresters has included the revamping of 110-kv. oxide film lightning arresters at the Adams and Harriman stations from four-legged to three-legged units, reducing the number of cells from phase to ground.

Co-ordination of insulation at high-voltage substations has long been routine engineering practice on this system, but at the new Melrose substation of the Tewksbury 115-kv. tie line the layout is fairly typical. Here the maximum insulating values are provided by the step-down transformer bushings; the insulation of the air-break switches comes next, followed by that of the bus insulators (seven 5¾-in. disks with arcing rings) and lastly that of the grounded neutral arresters. The chart (Fig. 1c) indicates the relative co-ordination values in terms of impulse crest voltage plotted against time lag. In brief, the chart indicates that if an arrester should fail to function the flashover would take place at points which would result in minimum damage, working back to the transformer bushings as the final line of defense against surges.

At the South Street generating station in Providence 35 oil circuit breakers have been changed over on one set of the 11-kv. buses to utilize "Deïon" grid construction. The objectives have been to shorten the arcing time from about 8 cycles to 2 cycles, eliminate oil throwing, cut down the arc energy, simplify maintenance and increase system stability.

Automatic control of lines supplying energy to substations has attained considerable prominence on the New England Power Association system. At Spencer, Mass., two 66-kv. circuits running between the lower Deerfield plants and the Millbury dispatching headquarters are tapped (Fig. 6) to supply the local utility requirements.

During normal operation a preferred line supplies the substation. During this time the second, or auxiliary line, is energized and its air-break switch is open. In case the preferred line becomes de-energized a time delay of three minutes occurs, and if re-energization does not occur the air-break switch of this line opens. After a 45-second delay the auxiliary line's air-break switch closes. If this auxiliary line is alive the substation becomes energized and the air break stays closed.

If, on the other hand, the auxiliary line is dead, the auxiliary line air break opens after a time interval and the entire sequence is repeated, until the substation is re-energized.

The air-break switches are motor-operated, direct current being supplied by a storage battery which is equipped with an automatic charging outfit. Automatic operation is also provided for the Spencer-Charlton tie line referred to above. Other substations are equipped for so-called "flip-flop" feeder selection, the layouts depending on the local conditions.

At Greendale substation, Worcester, two 13.8-kv. feeder oil circuit breakers have been equipped with instantaneous automatic reclosing relays. These restore the feeder to service by one reclosure operation after the occurrence of a fault. If the fault persists, further closure of the circuit must be made by manual control.

Layout Refinements Feasible

These examples of modernization represent but a few of the many steps taken in the past few years to improve transmission service on the New England Power Association system. Many refinements in the layout of circuit-breaking equipment and outdoor bus arrangement have become feasible as loads have increased and investment in more flexible facilities justified. The trend toward wooden supports in place of steel has become somewhat marked below the higher voltages of 220 and 110 kv. In the space available only a brief account could be presented of typical improvements which are continuously being effected. From time to time it is anticipated that the analysis and treatment of individual case problems will be available from this source.

COAST COMPANY ENHANCES PROTECTION

By A. V. JOSLIN
Assistant Engineer Pacific Gas & Electric Company, San Francisco

A recent installation of protective equipment is in connection with the addition of a 50,000-kw. unit to the present steam generating plant at station "C," Oakland. The location of the new unit at station "C" necessitates a 3-mile, 110-kv. underground transmission circuit to station "X," where connection is made to a set of 100-kv. lines for transmission to the general system. This 3-mile, 3-phase, cable circuit is to be protected by a 6-cycle pilot wire relay installation. The pilot wires are part of a cable which also carries the wires indicating oil level at various points on the 100-kv. cables, thus providing pilot wires at a reasonable cost. For "back-up" protection cable circuit will have directional overcurrent relays at each end.

The 60,000-kva. transformers bank connecting the 100-kv. cable circuit to the 12-kv. buses at station "C" will have percentage differential relay protection with a trip suppressor to prevent relay operation due to magnetizing current inrush. The trip suppressor will not prevent relay operation for transformer faults during the magnetizing current inrush period. The back-up protection for the 100-kv. cable circuit will be connected to afford back-up protection to the transformer bank.

Increase in system load, with its attendant stability problems, will require that the speed of clearing high-capacity faults from transmission circuits be materially increased. For this purpose current balance relay protection was recently added to the parallel 110-kv. circuits between Newark substation and San Jose, and similar protection is to be added to the Newark-Oakland 110-kv. circuits. At present our transmission problems demand neither high-speed oil circuit breakers nor carrier-current relaying, but when the load reaches the magnitude which requires them their installation will come as a matter of course.

Station C Protection Expanded

The original system of protection for the 12-kv. buses and feeder circuits at station "C" is being revamped to obtain fast fault clearances so as to remove the danger of system instability. The new relaying for parallel feeders consists of instantaneous current balance relays. Single-feeder circuits are to be protected by directional overcurrent relays with instantaneous trip attachments set for the dangerously high current values. All feeders have overcurrent induction relays for back-up protection. The two 12-kv. station buses will have full differential protection.

Power Hammers Drive Ground Rods

Above, Gasoline-engine and, right, compressor type hammers.

LIGHTNING FRUSTRATED BY BETTER GROUNDING

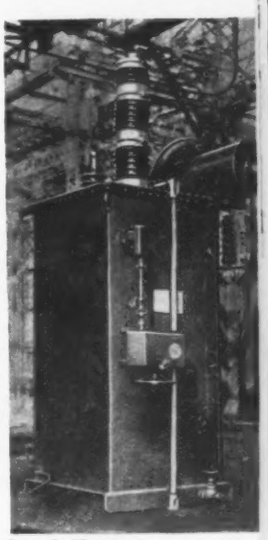
By R. M. SCHAHFER
Mechanical and Electrical Engineer,
Northern Indiana Public Service Company, Hammond, Ind.

Modernization has been intensively carried on to improve service on our 132-kv. steel tower lines, much of which are located in sandy soil where tower footing resistances were high and the lines were subject to lightning flashovers. On existing lines it is often difficult to improve shielding and increase insulation. The least expensive modernization work is to reduce footing resistance. Where a large number of ground rods are to be driven, and many driven to considerable depth, it is necessary to use coupled extensions. Power hammers (see illustrations) are also necessary.

We have completed the grounding of 185 circuit-miles of 132-kv. lines. About 45 miles of lines were completed before the 1937 lightning season, and this section did not have an interruption in 1937. In previous years this same section had from four to ten interruptions per year. In a stretch of 23 consecutive towers ground resistances as found ranged up to 42 ohms. All were reduced to 6.5 ohms or less. This required from two to eight rods at each location. Many had to be 50 to 80 ft. long. One 31.8 ohm site was reduced to 6.5 by driving one 75-ft. rod and one 105-ft.

PETERSEN COIL FOR 33-KV. SYSTEM

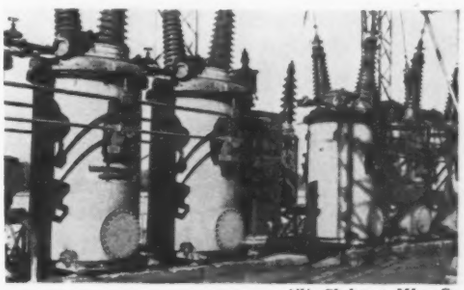
Ground fault neutralizer in station on 33-kv. power transmission system of the Public Service Company of Indiana, Terre Haute.



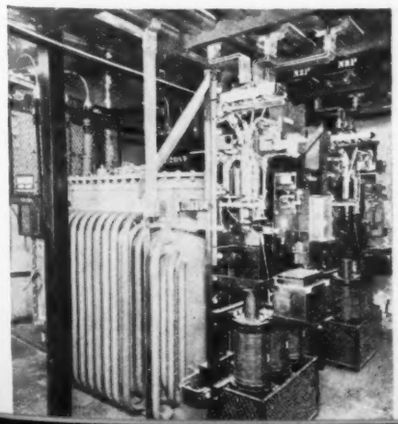
General Electric Co.

110,000-VOLT CIRCUIT BREAKER

Brown-Boveri 110-kv. oil circuit breaker, modernized with A-C Ruptors, as installed at Mount Island station of Duke Power Company.



Allis-Chalmers Mfg. Co.



TYPICAL SECONDARY NETWORK VAULT ON BOSTON EDISON SYSTEM

14-kv. primary cables and potheads screened from accidental contact, wide separation between potheads and transformer casings (non-inflammable liquid used in transformers), secondary buses mounted below ceiling for maximum clearance, network protectors and screened balancing reactors in foreground. Accessibility of protector equipment is an outstanding feature of the layout.

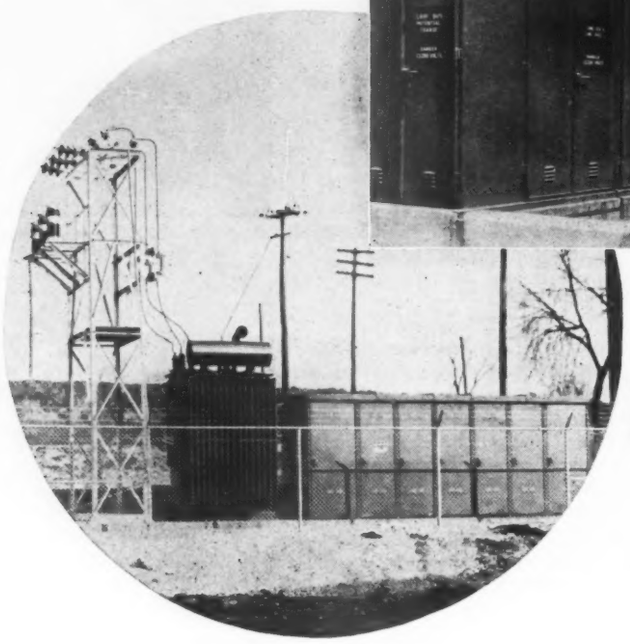


Fig. 1—Metal-Inclosed Outdoor Substation, Pittsburgh Glass Company, Milwaukee

Fig. 2—Unit Type Substation on Property of a Utility in the Middle West—1,500 Kva., 13,800/4,150 Volts

By W. E. GUNDLACH
Chief Electrical Engineer
Milwaukee Electric Railway & Light Company

Distribution Substations Demand Best of Engineering Talent

IN RECENT YEARS it has been the utility engineer's job in the design of system additions and changes to make one dollar go as far as two or three did before, and so with little or no sacrifice in quality of service. This has been just as true regarding substations as other parts of the system and has required a slightly different attitude on the part of the designing engineer. In the past one of his guiding thoughts has been *completeness* of layout. He has had to have a fairly good knowledge of system operation in order to *include* everything *essential* to the job. Now he needs a still better knowledge in order to *exclude* everything *non-essential* to the job. In some instances, such as important urban or bulk power stations and a.c. network vaults, continuity of service is paramount, but even here there is a premium on economy of design or operation. The substation engineer of today has the following principles upon which to work:

1. Simplification of design and operation is always desirable.

2. Substitution of new types of equipment or materials should be made whenever they (1) result in greater economy or (2) are better adapted to the job.

3. Items should be eliminated that cannot be adequately justified based on operating experience.

4. Immediate savings are often preferable to over-all long-term economies.

5. Our customers are expecting (and demanding) a higher quality of service each year. Therefore, where it is necessary to sacrifice something for the time being in the way of service quality, it should be done with the thought of improvement at a later date.

Most of the above principles work for more economical design, and this in turn is ultimately reflected in lower rates. Where work is deferred in the immediate interest of economy, it means a "back-log" of construction work that will proceed just as soon as capital funds are available and there is some assurance of business recovery.

Metal Inclosure the Trend

Perhaps the outstanding trend in substation design in recent years has been the use of metal-inclosed switchgear and equipment. There are many kinds of so-called "metal-inclosed" equipment, but most of them embody features of simplicity, compactness, good appearance, safety, flexibility and factory assembly. If utilities once get started on an extensive modernization program for substations and generating stations we are likely to see large use of this metal-inclosed type of design, because in addition to its other attributes it lends itself to use in confined spaces. Fig. 1 shows a recent outdoor installation of metal-inclosed equipment at an industrial plant in Milwaukee where continuity of service and safety were essential factors.

A special type of metal-inclosed design is the unit type substation consisting of step-down transformer, regulating equipment and outgoing feeders. A typical recent installation is shown in Fig. 2. Many features are claimed for this type of substation, but its chief advantages are low first cost, factory assembly and mobility. In these days of uncertain industrial loads it is worth something to be able to shift a substation from one location to another to meet changed conditions. However, with a return to more normal load growth, we will undoubtedly return to the design of the larger and more permanent substations which will show long-term economy.

Simplification of design is accomplished in many ways. There is a definite trend toward elimination of duplicate buses and transfer and spare

equipment. This may be justified on the basis that modern equipment is of better design and therefore is out of service for repairs or maintenance less than the older type of equipment. Many companies are now keeping more nearly complete records of equipment outages and servicing. This has helped the engineer in the elimination of unnecessary duplicate or reserve equipment. Coincident with the omission of duplicate buses has been a greater use of sectionalizing features and the spreading of important lines over different bus sections.

Recent electrical failures in some of the larger stations throughout the country have emphasized the importance of adequate protective schemes and this phase is being given increased attention by the substation engineer.

Fuses and Breakers

The substitution of less expensive equipment that will give equivalent (or at least adequate) service is manifest in the rather wide use of reclosing fuses in place of feeder oil circuit breakers in smaller distribution stations, particularly in rural areas. A typical example is shown in Fig. 3, which is a recent 1,500-kva., 26,400/5,000-volt substation serving a suburban territory adjacent to Milwaukee. A very good quality of service is essential because most of the load is residential in character, with a large percentage of homes equipped with electric ranges, refrigerators, water heaters, oil burners, stokers, pumps, etc. The three outgoing feeders are protected by a modern design of three-shot repeater fuses. A saving of $3,000 was realized in using repeater fuses instead of automatic reclosing oil circuit breakers. Experience with repeater fuses at other substations in recent years has proved that the quality of service is not jeopardized by their use in place of oil circuit breakers.

It may be of further interest to note that in the design of this substation prolonged outages as a result of the failure of the supply line are avoided by the use of an automatic change-over scheme, using motor-operated air-break switches to transfer the substation to an emergency supply line.

Reclosing Fuses Employed

Another instance of the substitution of fuses for oil circuit breakers with resultant economy is shown in Fig. 4. Here 34.5-kv. high-interrupting capacity fuses have been utilized to protect each of two 1,500-kva., three-phase rotary converter transformers. The capital saving realized was approximately $8,000. The Milwaukee Electric Railway & Light Company has operated rotary converter substations along its interurban railway system for many years, using only liquid type fuses for high-voltage protection. In the urban area, however, oil circuit breakers have been used to obtain flexibility of operation and secure adequate interrupting capacities. Recent improvements in the design and interrupting capacity of high-voltage fuses have made them available for use in the urban area. In each case an air-break switch is provided ahead of the fuse installation for use in disconnecting the transformer when the conversion equipment is not being utilized and for de-energizing the circuit for fuse replacement.

Reclosing high-voltage fuses have been developed in recent years and are being used by several operating companies for rural or industrial substation protection. We have one such installation on the Milwaukee system on a 26,400-volt tap line, 10 miles in length, and it has given very satisfactory performance.

One idea that has been attractive to at least one company has been the doubling up of two distribution feeders on one feeder oil circuit breaker. The resultant saving on a new feeder may run as high as $5,000. On the average, this will double the number of customer outages due to feeder troubles. Whether or not this can be tolerated depends upon the feeder outage record. Here again accurate records of service outages come to the aid of the engineer.

A Large Backlog of Obsolescence

Substation jobs are always expensive, relatively speaking, because the work does not lend itself to small increments that can be added each year. This, in part, accounts for the fact that every request for appropriations for such work is scrutinized with great care. The engineers use every means possible in these lean years to postpone such appropriations as long as possible, using less expensive alternatives that are either permanent or temporary in nature. Sometimes these take the nature of line type regulators and step boosters, and sometimes power factor corrective equipment is utilized.

There is one characteristic of the electrical industry that has been manifest since its inception and will continue to exist for many years to come. That is that it is never *static*. Changes, new developments and new applications are constantly being made. The utilities have always been alert to take advantage of any improvements or new developments that would ultimately result in lower rates or better service. Extensive modernization or rehabilitation of existing electrical systems have reached beyond the idea stage with many utilities. Plans are being laid out so that, when the proper time comes, they can be pursued orderly.

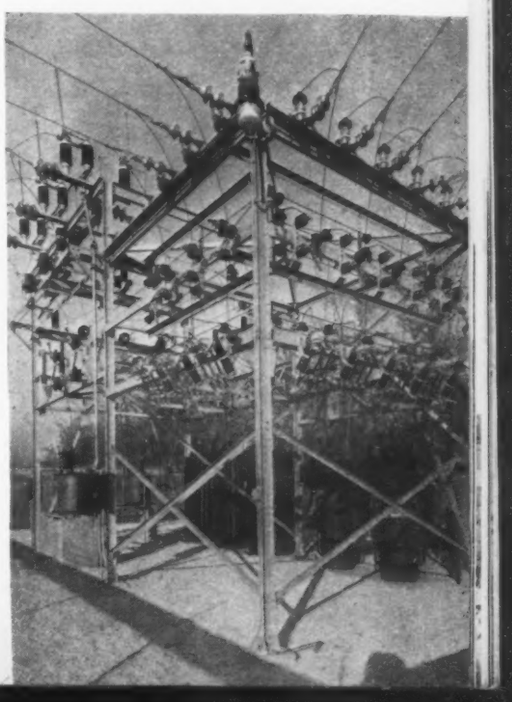
Most large systems have witnessed their substation equipment, such as oil circuit breakers, regulators and protective equipment, become obsolete or of insufficient capacity for the duties imposed. Some of this can be modernized by investments of a fraction of the original cost, while the rest must be replaced entirely. In this field there is a tremendous "back-log" of future construction work.

Network Makes Steady Progress

Another evidence of the ability of utilities to make changes whenever it was to their advantage to do so is evidenced by the many changes in voltages, frequencies and other system characteristics that have been made in the relatively short life of the industry. There are probably few large companies that do not have some sort of a change-over program continually in progress. It may be a change from 25 to 60 cycles, two phase to three

Fig. 3—Howard Avenue Distribution Substation of the Milwaukee Electric Railway & Light Company

Voltage 26,400/5,000. Three outgoing feeders are equipped with three-shot fuses, representing a saving of $3,000 over cost of oil circuit breakers.



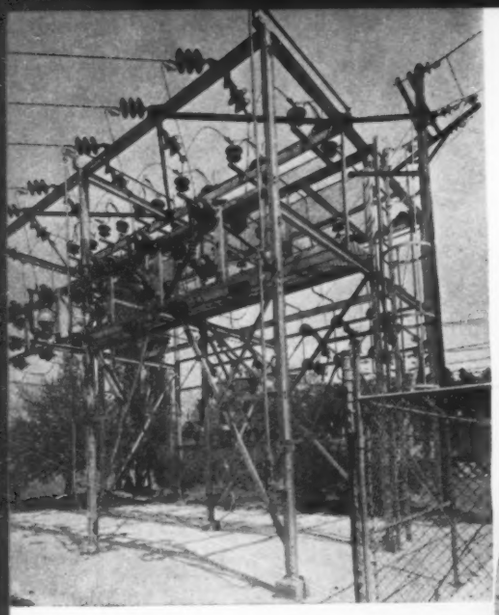
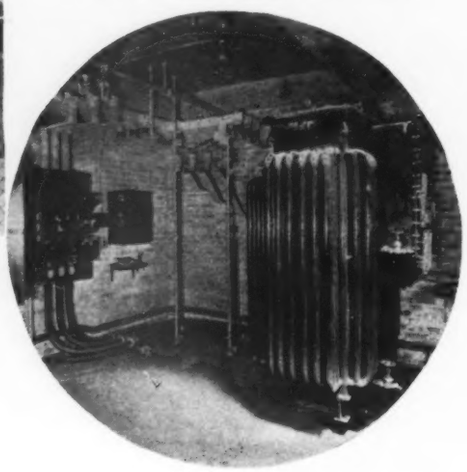


Fig. 4—High-Voltage Fuse Protection for Two 1,500-Kw. Rotary Converter Transformers

A saving of $9,000 was made by using fuses instead of oil circuit breakers at Burnham Street substation of the milwaukee Electric & Light Company.

phase, three wire, three phase to four wire, three phase, or an Edison d.c. network to a low-voltage a.c. network. Most of these programs are based on sound economic justification and will proceed as fast as capital funds are available or present equipment wears out.

Fig. 5—A.c. Network Vault Supplying Service to the F. W. Woolworth Company Building, Milwaukee



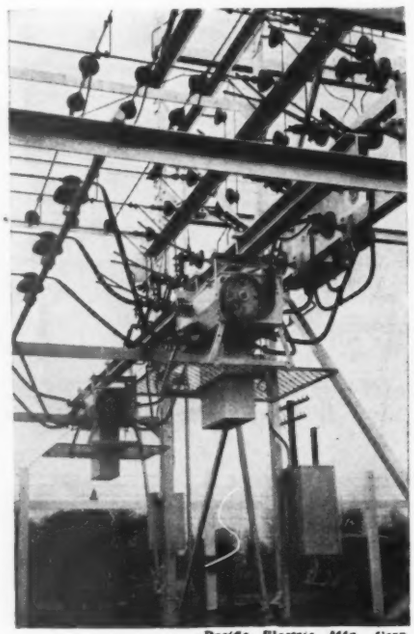
Loads Wait Business Turn

In Milwaukee a program for the development of a low-voltage a.c. network system which may ultimately supplant the Edison d.c. system has been in progress for several years. A recent network vault installation is shown in Fig. 5, consisting of two 450-kva. transformers and two 1,600-amp. network protectors. This vault supplies service to the new F. W. Woolworth store which was greatly enlarged and modernized last year. The demand was increased from 125 kw. to 475 kw., or 280 per cent.

This is a typical illustration of the potential loads that await utilities as soon as air conditioning and modernized lighting programs can be undertaken by more commercial establishments. Many large establishments are appreciative of the value of store and building modernization, but do not feel that they can undertake them until business in general is established on a firmer basis.

RECLOSING CIRCUIT BREAKERS

Service restorer (7,500 volts) installed at Silverton, Ore., substation of Portland General Electric Company reduces time of line outages.

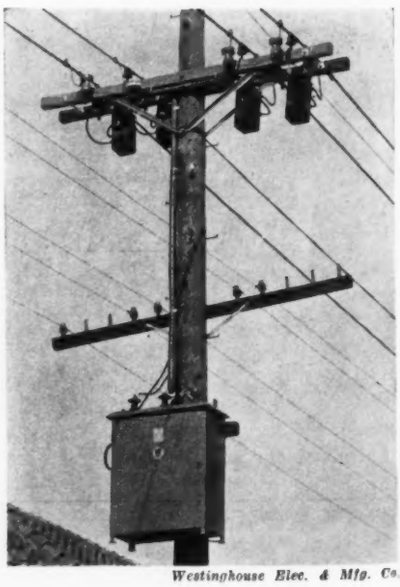


Pacific Electric Mfg. Corp.

General Electric Co.

FOR RURAL DISTRIBUTION

Right through trees, obviating necessity for trimming, goes this aerial distribution cable. Note "saddle" support at pole.

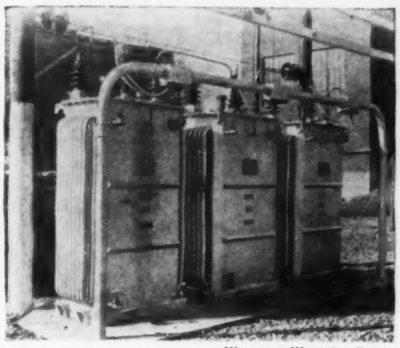


Westinghouse Elec. & Mfg. Co.

POLE-MOUNTED AUTOMATIC CAPACITOR

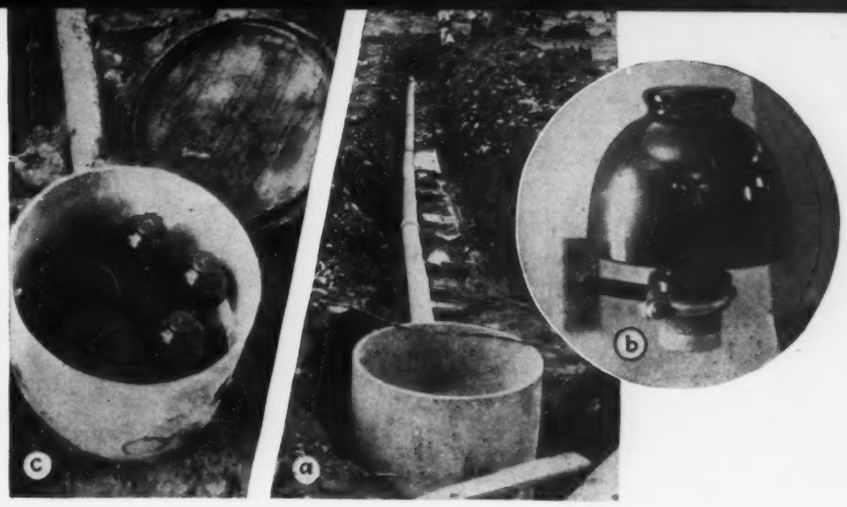
Union Electric Company of Missouri installation of pole-mounted automatic capacitor.

DISTRIBUTION SUBSTATION INSTALLATION



Wagner Electric Corpn.

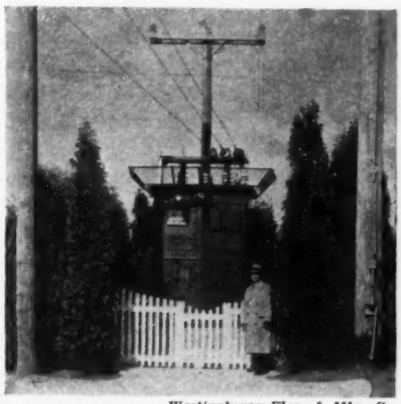
Substation installation of three 333-kva., 23,000/2,300-volt distribution transformers in Tarkio, Mo.



CUTS DUCT LINE COST

Striking economies in construction have been attained by the Belmont (Mass.) Light Department by the use of Johns-Manville 4-in. asbestos-cement duct for 115-230-volt secondary distribution (a) in 18x18-in. trenches. Customers' three-wire services are tapped from General Cable fixtures (b) protected against water by small diving bells and mounted in 24x24-in. Johns-Manville hand-holes (c) having a capacity of seven services each. These hand-holes, complete with bells, are installed at an average cost of $49.60 each, compared with about $125 for a 5x5-ft. brick manhole alone. The telephone company's jute cable shares the trench.

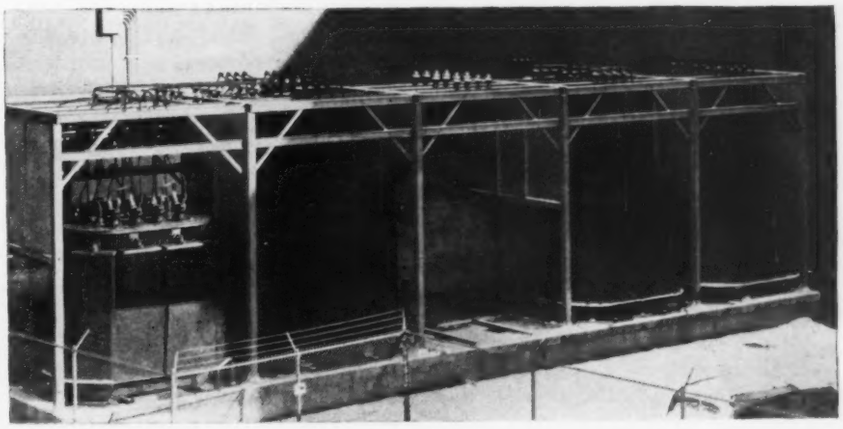
PORTABLE TRANSFORMER SUBSTATION



Westinghouse Elec & Mfg. Co.

Philadelphia Electric Company's 1,000-kva. transformer substation is type CSP, portable, quickly installed.

ALL APPARATUS ABOVE 1936 FLOOD PEAK



Hartford Electric Light Company's new distribution substation at Pearl Street exemplifies conflagration and flood-proof construction.

Four 11 to 4.8-kv., 4,000-kva. transformers with space for a fifth were located outside the building. New operating room with bus and switching facilities in the upper floors insure freedom from anxiety should the waters rise again.

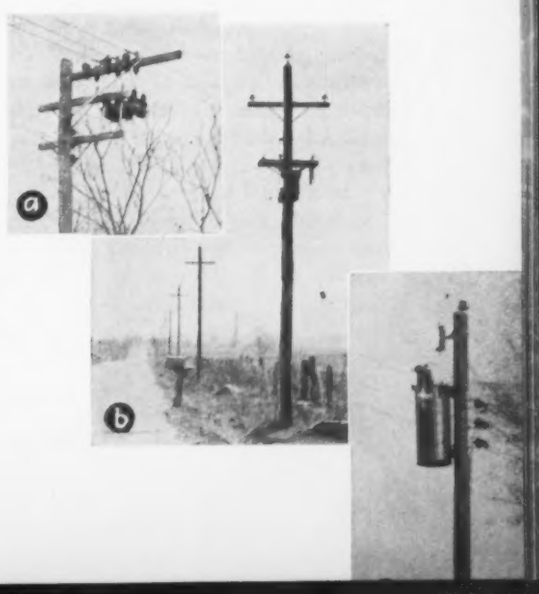
CAPACITORS AND COMMON NEUTRAL ECONOMY MEASURES

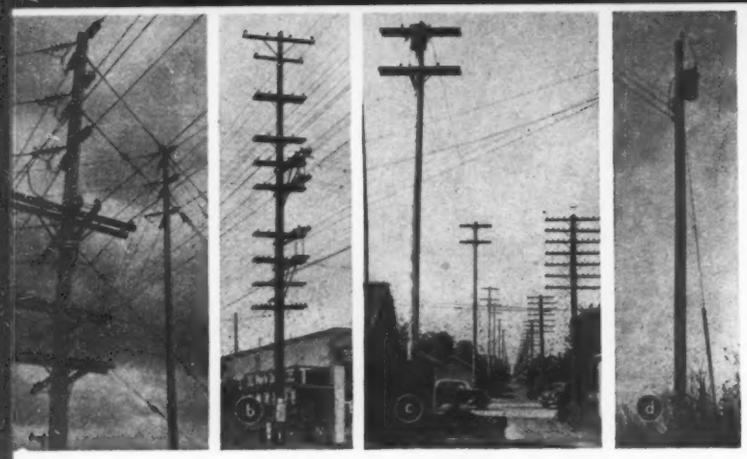
By E. J. KALLEVANG

Chief Engineer Wisconsin Power & Light Company, Madison, Wis.

Two arc welders and a motor load in a creamery occasioned low p.f. and voltage overcome by putting three capacitors (a) near the end of the long 2.3 kv. feeder serving them.

The installation averted a major reinforcement of distribution. Gain was had from converting a 13.2 kv. delta light-transmission line (b) to 11.9 kv. wye. The 2.3 kv. rural line below it was retired. New single-phase 6.9 kv. rural extensions and transformer installations are considerably cheaper than 13.2 kv. and perform better than 2.3 kv. Common neutral is used on a 6.9 kv. single phase rural line (c). When street lights are added the same neutral will serve for the cascade multiple street light circuit.





All Voltage Categories Susceptible to Modernization

(a) Complicated corner construction and guying simplified by use of modern pole line hardware and devices.

(b) Heavy lead, ample clearance, all utilities combined in suburban commercial area.

(c) Primary one-wire (single-phase of 4 kv. 3-phase system) common neutral with 3-wire secondary.

(d) Multi-grounded common neutral distribution for inexpensive rural extensions (Iowa Southern Utilities Company)

By M. T. CRAWFORD
Assistant Chief Engineer,
Puget Sound Power & Light Company,
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Modernizing Distribution Overhead for Service

IF THERE is any place where a "planned economy" has been needed for electric utilities it is in the electric distribution system. Experience during the years of rapid expansion and load growth preceding the depression convinced utility engineers that money spent for additions and reinforcements was not a prudent investment unless it dovetailed with an intelligently thought-out ultimate plan for future development. It was sometimes found that while the mere addition of heavier copper to relieve overloads or low-voltage complaints remedied the immediate needs of the situation, still further load growth involved, sooner or later, a more radical change such as higher voltage or change in area feeding point, so that the work of reinforcement done a few years ago had to be pulled out and done over again.

In order to avoid the economic loss of such procedures distribution engineers have everywhere shown the disposition to look ahead. The usual engineering problem is, first, to plan a distribution system which will most efficiently fit the anticipated load conditions; second, to make certain compromises in this plan in order that any existing system investment can be utilized for the time being with a minimum of waste, and, third, to provide for the gradual shaping of the existing system into the ultimate plan as reinforcements and replacements are made. Distribution systems are not built in their ultimate form all at once, but must be built gradually with the development of the community and load.

The long-range planning procedure involves selecting the general type and voltage of the primary and secondary distribution in each load area which will be best adapted to the service conditions, such as industrial, commercial, residential or rural. The location and type of distribution substations can then be decided upon, following which the high-voltage distribution system or subtransmission system may be planned, to provide the most efficient means of supply from the primary sources of power. This comprehensive whole must be laid out with an eye to the anticipated future condition of load saturation in each area. Having completed the general plans for a number of years into the future, it is then much easier to plan each year's work and meet the immediate needs with construction units which will fit the ultimate program.

Rehabilitations and Modernizations

Utilities have continued steadily throughout the depression period with a program of extending rural lines to supply electric service to more and more farms and homes. Studies of the load area and estimates of the future conditions at time of saturation will perhaps indicate that the 2-kv. or 4-kv. primary voltage will not be ultimately economical. Prudent investment engineering has in the meantime been looking ahead toward the ultimate, and poles have been set with sufficient clearances, and possibly insulators provided of suitable rating, to permit raising the primary voltage to the value anticipated in the long-range plan. Under such conditions it is only necessary to replace the mobile units, such as line transformers, and raise the voltage on one section at a time.

In a Puget Sound city of about 35,000 population a former 2-kv., two-phase, four-wire primary distribution was first changed to 4 kv., three-phase star by simple reconnection and then followed by adaptation of common neutral schemes, eliminating the primary neutral wire throughout the load area, except between substations and feeding centers. Permission was obtained for complete bonding of the neutral grid to the water systems. Transformers were banked together on an extensive network of secondary mains and by a system of careful load supervision they were kept down to such size as was necessary for adequate handling of the load. Over a period of years, this rehabilitated distribution system has taken on a much more efficient aspect, represents a far greater load-carrying capacity and has proportionately fewer conductors and transformers than before.

By intelligent planning many jobs of rehabilitating inadequate or obsolescent sections of distribution system have been made to accomplish more than one objective. Not only have losses been recaptured and service improved in the locality but equipment has been salvaged which has been placed at various locations to meet other needs.

Materials and Methods, Standardization

Consistent progress has been made in adapting new materials and tools to further distribution economy. In the matter of pole-line hardware alone there have been numerous improvements which have produced a stronger and more durable construction at less cost. For instance, the old method of

attaching guy wires to poles by wrapping around over shims with hand make-up splices has been largely superseded by bolted clamps, thimble-eye bolts and nuts, the guy wire loop and saddle, etc. Many utilities have analyzed their costs carefully and have modernized their line-wire splicing procedure, by using solderless connectors and automatic line-wire splices, eliminating the uncertainty of hand-made splices and reducing costs.

Utilities with distribution systems in areas somewhat remote from powerful commercial broadcasting stations have been very careful to select line materials which are free from radio interference. Insulators, hardware assemblies, cutouts, switches and devices are subjected to visual corona tests before acceptance.

In order to adopt mass production methods there is nothing more important than a well-designed system of work sketches and detailed planning, with a book of standard practices. Well-kept-up universal maps of each load area are the only means of avoiding loss and waste of time, and it is necessary to make a record of each job of work done if these maps are to be kept up to date. It is also necessary to plan each job in advance and make record of the plan on some form of work sketch, in order to avoid the waste which results when a line foreman has to stop and plan his job before the men can go to work. Mass production of a large number of work sketches can only be attained where the types and details of construction have been worked out with care and thought in advance and covered by standard practices. The preparation of work sketches has thus become largely a matter of using judgment in the general design features and applying the proper standard practice to the details. The construction crews have become more proficient and produce more uniformly reliable work, since they consistently follow standard methods and construction practices.

Guying has been worked out in the form of graphs and tables, so that it is possible to select the durable and safe size and type of guy wire, anchor and attachment for each installation by brief reference to the standard practice.

Rule of thumb methods of determining when pole replacements are necessary have been superseded by more accurate methods of determination. Precalculated tables of safe strength under the various conditions of loading, types of soil, etc., make it possible for the inspector to apply known data in connection with length of span, number of conductors, size of pole, etc., and determine from charts just when the pole is unsafe or approximately how many years of life still remain. A circular slide rule developed by John C. Craig, one of the Puget Sound Power & Light Company's distribution engineers, described to the Seattle Section A.I.E.E., facilitates rapid determination of pole-replacement data.

Reclamation Found Profitable

Many utilities have established salvage bureaus or reclamation departments, with highly organized facilities for eliminating the waste which results from accumulating and scrapping materials brought in from various jobs of maintenance and construction. Around $18,000 per year net saving after deducting costs can be effected on a distribution system which would ordinarily scrap about 150,000 lb. of wire per year in lengths ordinarily considered too short to use. This involves the installation of special machinery at a central warehouse to which all scrap wire of every kind is returned and is sorted out as to size and type.

In the case of No. 4 weatherproof wire, for instance, pieces as short as 15 ft. may be economically salvaged by splicing machines which produce a smooth compression splice and straighten, reel and tie in standard bundles, at a cost of between 1 and 2 cents per pound. Shorter pieces are cut up, bundled and issued for tie wires. Where the insulation is defective on weatherproof wire a stripping machine has been developed which removes the insulation for about 1 cent per pound and the wire can then be spliced and reeled for use as bare wire. Short pieces can be made into ground coils to be buried under poles. Rethreading and galvanizing bolts, crossarms, braces and hardware at around 3 cents per pound, cleaning and reconditioning of service knobs, cutouts, insulators, switches and units of equipment for other departments of the utility are feasible. By keeping an accurate list and description of reconditioned equipment units an engineering department can substitute on purchase requisitions for new equipment and effect a continuous economy.

Falling off in load made it possible to reduce their purchases of new transformers by replacing underloaded units with smaller transformers. With a growth in load, an adequate and reliable scheme of keeping check on the transformer loading will enable much more efficient use of this large proportion of the distribution investment.

Lewis and Snyder of the Public Service Electric & Gas Company have given an example of what had been accomplished in a few years, showing that a saving of 4,300 kva. in rated transformer capacity was effected in the face of a 5,000-kva. increase in circuit loads, amounting to a transformer investment economy of about $30,000. An article in ELECTRICAL WORLD of January 16, 1937, by R. Rader indicates one method of such load supervision which has been very successful.

Service Betterment Builds Load

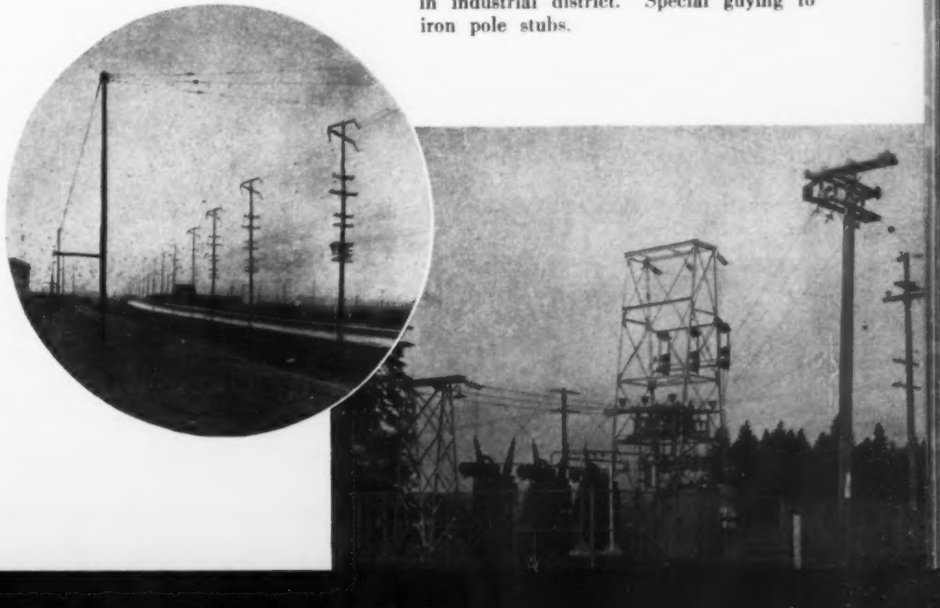
Tangible proof was afforded in one situation where automatic voltage regulation was provided, so that the customer's delivered voltage was held within a close range, replacing an inadequate scheme of regulating voltage at the source. In another instance, where a small independent system had been acquired by a large utility, it was found that a large suburban and rural area had a very light load density. Service had been supplied by an inadequate submarine cable with periodic service interruptions. The new owners provided duplicate cables, improved switching and relaying facilities, better voltage regulation and reduced rates. Within a few years the entire area was well developed with numerous electric ranges, water heaters, electric brooders and a large number of additional customers.

The modern methods of bettering

Modified Primary Network Supplies Rural and Suburban Areas (below)

Several Utilities Join in Pole Line (in circle)

Heavy combination transmission and distribution lead on an arterial thoroughfare in industrial district. Special guying to iron pole stubs.

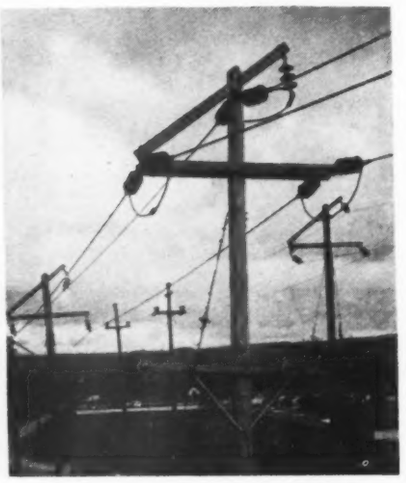


service include the use of networking principles in the design of the distribution system, together with ingenious relay schemes, reclosing switches and fuses, automatic regulators, and the like. Primary networks, with the simplified or unit type transformer installations instead of more elaborate distribution substations, have been used with considerable saving to improve service in well-built-up residential and semi-commercial areas. The economy of such installations depends upon a growth in load, and in many cases the construction necessary for immediate needs has been made in such a manner as to permit changing to a network at a later date. A simplified primary network in which the burn-off possibilities of overhead primary feeders is utilized, described by Messrs. Tenbrook and Kidder of the Philadelphia Electric Company, is an excellent example of an economical development for handling growth in load with moderate increased investment.

Outages Under Better Control

Good progress has been made in improving the general plan of circuit protection for the purpose of clearing troubles promptly and effectively. Inexpensive types of automatic reclosing oil circuit breakers for mounting on cross-arms, together with still less expensive automatic reclosing fuse cutouts, have been given extended use for separately protecting branch taps from main primary feeders, so that a fault on a branch line will not necessarily involve an outage on the entire feeder. There has been a trend toward improving the selectivity and co-ordination between the individual transformer fuse, the branch line fuse or circuit breaker and the feeder circuit breaker at the substation, by the installation of carefully selected relays on the main feeder circuit breaker. On star-grounded primary systems residual relays in the neutral have been used to reduce the fault clearing time and also improve the co-ordination with fuses at outlying points.

While certain areas are comparatively free from serious lightning interference, many sections of the country are confronted with a definite equipment loss and service interruption each year as a result of lightning storms. Different procedures in applying lightning arresters to individual line transformers have been used, such as interconnection of transformer ground and secondary neutral ground, either solid or gapped; the use of co-ordinated gaps and the installation of secondary circuit breakers inside the transformer case.



Wishbone (With Suspension) Replaces Triangular Pin Construction

Modernizing 44/66-kv. line at time of pole replacement eliminates radio interference and hazard from pole-top fires.

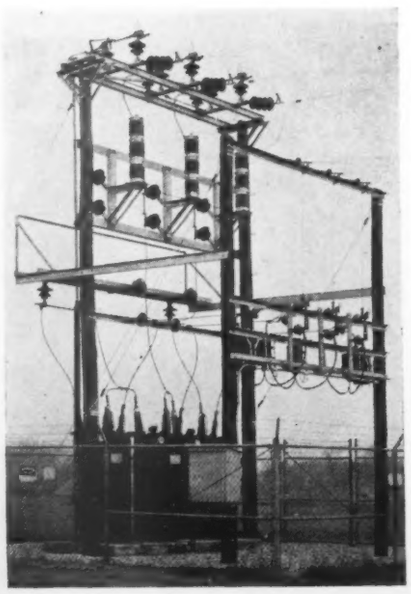
Another definite step forward is the improvement of facilities for communication between dispatching centers and mobile units of the operating and maintenance organization, with the allocation of frequency bands for power company radio communication by the Federal Communications Commission. Trial installations have been made which permit dispatchers to keep in constant touch with the foreman on line trucks, greatly facilitating the location and repair of trouble. With an increase in load and revenue, installations of this type of equipment will undoubtedly become more widespread.

The analysis of system troubles and economic studies of their cost and means of correction have been made by a number of large utilities. Reports in E.E.I. committee meetings and an article by W. B. Elmer in the ELECTRICAL WORLD, October 23, 1937, give concrete information in regard to corrective measures which can be applied to the construction of the distribution system which will be economically justified.

A splendid job has been done in modernizing overhead distribution systems and improving the service, in the face of reduced revenue. It is also evident that, with the return of more favorable business conditions, the increased load and revenue will justify many extensions and reinforcements on distribution systems, the addition of protective and regulating equipment, providing additional facilities for operating communications, and many other similar improvements.

ALL-STEEL HOUSING, CONNECTIONS, CURRENT ELEMENTS ACCESSIBLE

Typical 500-amp., 4,500-volt, three-phase, four-wire regulated feeder position in new suburban Carondelet substation of Union Electric Company, St. Louis. Initial installation two 10,000/13,333-kva., 33/4.5-kv., three-phase transformers and five outgoing three-phase feeders.



COMBINE WOOD, STEEL FOR SUBSTATION ECONOMY

Here, applied to construction of substations for rural and small industrial loads on the system of the Indiana & Michigan Electric Company (American Gas & Electric Company) is a development of the idea of steel arm and wood-pole combination which may frequently be seen in some of the older transmission lines. The economy of the combination for this type of substation is obvious. For instance, the steel parts—all of them small and light enough for handling in an ordinary line truck—may be assembled in the shop, ready for bolting as units to the poles.

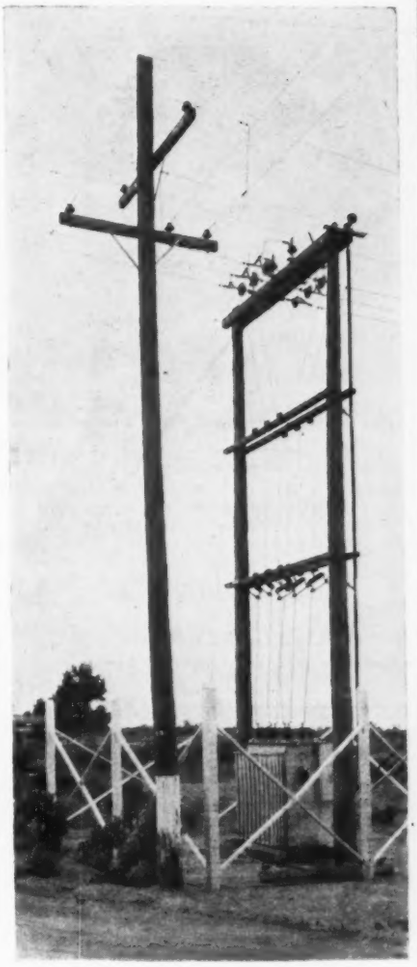
UNDERGROUND PROGRAM CONSISTENTLY HELD

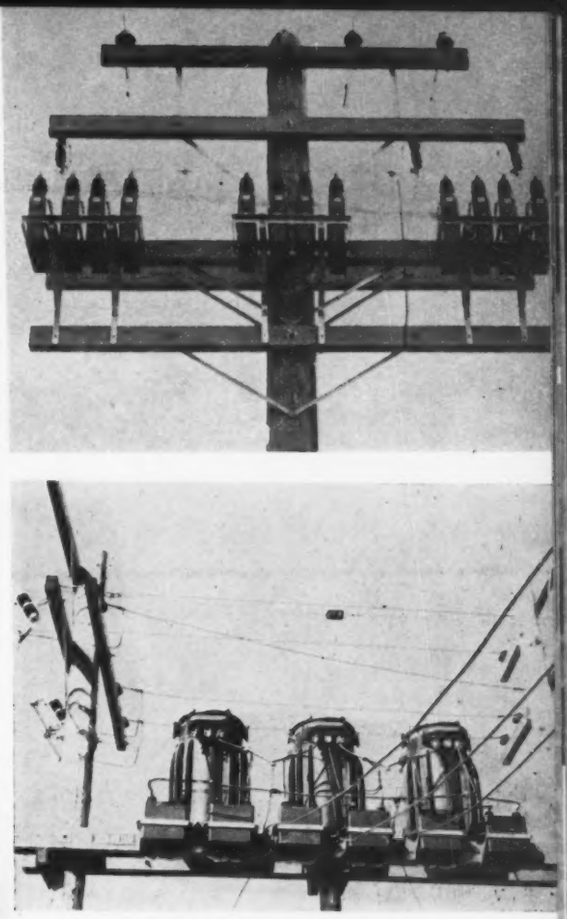
By C. H. JENKINS
Underground Engineer
Bureau of Power & Light, Los Angeles

There was no curtailment of the expansion program of the underground distribution system of the Bureau of Power and Light during the depression period. During the 1937 fiscal year there were 7.1 miles of conduit line constructed and 100 miles of cable installed, whereas the average for the six previous years was 12.5 miles of conduit line and 75 miles of cable.

This program included many miles of conduit and 34.5-kv. cable between receiving station and various distribution stations to permit the removal of overhead lines in densely populated areas. Several heavily congested overhead 4.8-kv. feeder lines from distribution stations to feeder centers were replaced with conduit and cable.

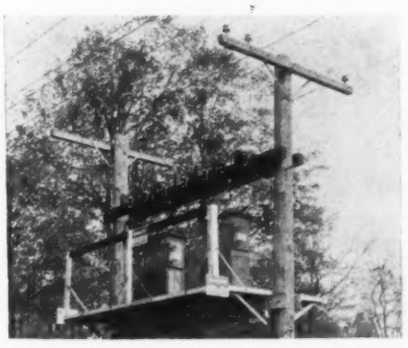
Purchase of the electric system of the Los Angeles Gas & Electric Corporation during 1937 made necessary the consolidation of the two properties. The former L. A. G. & E. a.c. system in the downtown area operates at 2.3 kv., which requires primary cable, transformer and equipment replacement to conform with the bureau's 4.8 kv. primary system. This work is being done gradually as needed to obtain the best operating results and will continue over a period of many years.





Capacitors and Regulators Enhance Loading Potentiality

Left—Step-voltage regulator transfers load from overloaded substation to one with space capacity. Top—Capacitors (180 kva. of 6.9 kv.) on 12-kv. line to raise power factor and increase load-carrying capacity. Bottom—Capacitors (90 kva. of 460 volt) on secondary of overloaded bank to obviate installing larger transformers.



BOOST VOLTAGE— SAVE ON LINE COPPER

To pull out existing wires and string heavier conductors on a 2,300-volt delta three-phase line of the Indiana & Michigan Electric Company (American Gas & Electric Company) for improvement of voltage regulation was an expense that could be deferred, perhaps avoided. This was done by installing the two 10-kva., two-step boosters shown here. And now the load in the community served by the line can continue growing for some time before the line must be rebuilt.

STEP-VOLTAGE REGULATORS TRANSFER LOAD

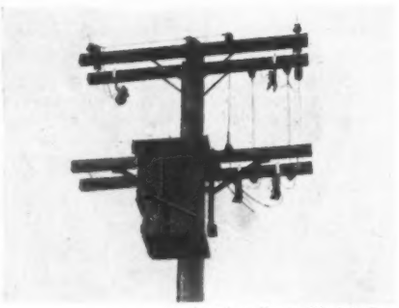
By H. H. MINOR
Distribution Engineer, San Joaquin Light & Power Corporation, Fresno, Calif.

Fluctuations in irrigation load and oil operations over the past unsettled six years created situations where some substations had considerable spare capacity, while others were more or less fully loaded. To meet this, among other measures, load was transferred from a loaded substation to an adjacent one having spare capacity by the use of step-voltage regulators placed on distribution feeders or interstation tie lines. While this practice increased losses somewhat and sometimes involved added line construction, it proved much less costly than necessary changes at the substations. Moreover, voltage regulation was greatly improved.

At other places voltages were "picked up" by means of step-voltage regulators either installed on an existing feeder or served by a new feeder which was operated exclusively as a regulator supply circuit. To have achieved the same result by added distribution lines would have required a much greater investment. In the event of future load decrease the regulators are highly salvageable; they are purchased in sizes and range to fit into a later bus regulation scheme at a substation.

Distribution type capacitors provided another means to gain load capacity for existing equipment. They were installed on motor-loaded distribution lines at a cost of approximately $10 per kva. installed, with the result of more load-carrying ability for the distribution feeder at better voltage. In addition, however, each kva. of capacitors will eventually replace a kva. of synchronous condenser capacity of comparable or greater cost. Thus benefit to distribution lines and substations may be considered as having cost nothing.

When confidence returns we can all proceed with construction less of temporary expedient nature, however (as a result of forced economy), more efficiently than originally planned.



American Gas & Electric Co.

COSTS LESS THAN LINE COPPER

Because of the characteristic short time durations of loads on farm lines, investment in line conductors of sizes based on perfect regulation for maximum loads would be idle a great part of the time. Therefore money can be saved and the cost of service consequently reduced by stringing line conductors adequate for average or median loads and using a booster to raise the voltage during the short heavy load periods. Here is a typical 5-kva., two-step booster on a single-phase rural line of the Indiana & Michigan Electric Company (American Gas & Electric Co.).

SIMPLIFIED SUBSTATION DESIGN

Small town distribution substations on the system of the Detroit Edison Company show the versatility of a very simple, low-cost design. The back-braced channel iron verticals support a rectangular frame that extends over the transformers and on which high-voltage fuses are mounted. Horizontal cross-member makes an excellent perch for lightning arresters.

Electric Compacter for Duct Concrete

Leaning vertically (above) against the power unit is the vibrating spud machine, which consists of a piece of 2x4-in. board attached to a ½-hp., 3,600-r.p.m. motor, vibration in application (at left) being effected by an eccentric weight on the shaft of the motor.

MACHINE TAMPS CONCRETE WATERTIGHT

By G. B. McCABE
Engineer on Cable Practice,
Detroit Edison Company

In all new conduit construction the concrete is vibrated or puddled to produce a more compact, watertight envelope for the ducts. A gas-engine-driven 60-cycle generator (1½ kva.) supplies the power to the motor which vibrates the spud applied at 1-ft. intervals along the conduit run. Where corrosive ground waters exist "Anti-Hydro" or calcium chloride is added for imperviousness. In very wet surroundings tar paper is used to line the trench to maintain the integrity of the original mix and render a less porous envelope.

Economies have recently been effected through adoption of thin-wall (¼-in. nominal thickness) fiber conduit.

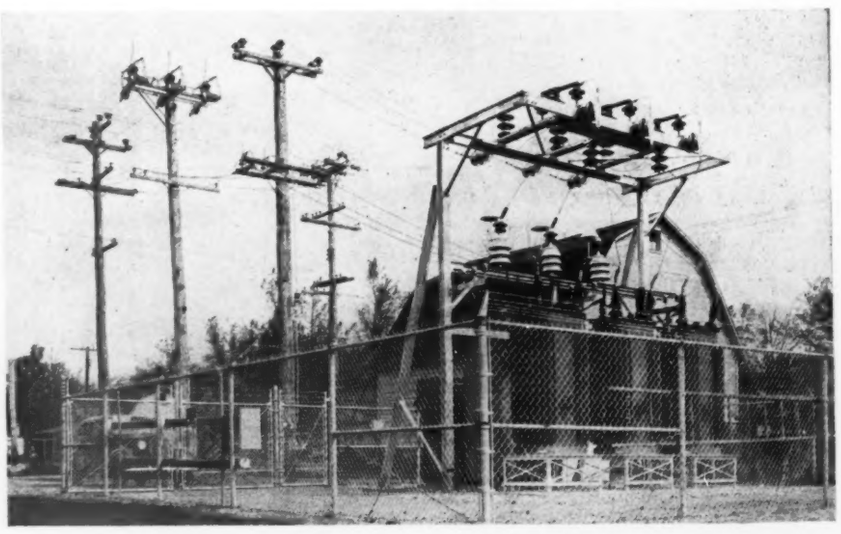
LOAD-CENTER SUBSTATIONS AND NETWORKS

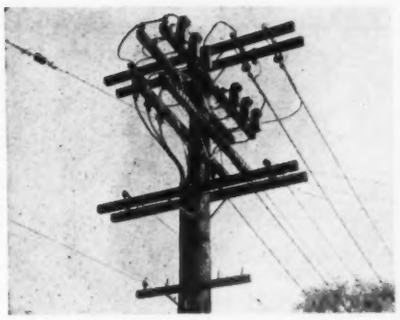
By C. A. CORNEY
Superintendent of Engineering,
Boston Edison Company

In the field of distribution substation modernization the scheme which permits the use of smaller units placed at strategic locations throughout the area, avoiding the necessity for the heavier type switchgear and thereby keeping to a minimum the investment in this equipment, has much to commend itself.

While no actual substation modernization installations have yet been undertaken, the primary network system, in which the Boston Edison Company pioneered in the use of factory-assembled units, has led the way to a solution. We have prepared plans involving two of our larger and more important substation areas which employ this basic principle in different respects. In the one area (fully described in *Electrical Engineering*, January 1934), the scheme which has the greatest merit contemplates the introduction (when loading conditions warrant) of a primary network system, the gradual extension of which will ultimately relieve the present substation.

In the other area, located in a thickly settled urban district which is now supplied by one of the older type substations where the switching equipment has become inadequate, it is the intention to use two of the existing substation transformers at the present site to feed a newly established primary network. The transformers will be connected directly to supply lines, with adequate secondary switching equipment for the transformers and circuits. An adjacent substation, whose circuits are largely contiguous, is being connected into the network, requiring the installation of a new transformer with a third point of supply consisting of another new transformer and a full complement of secondary metal-inclosed switchgear.



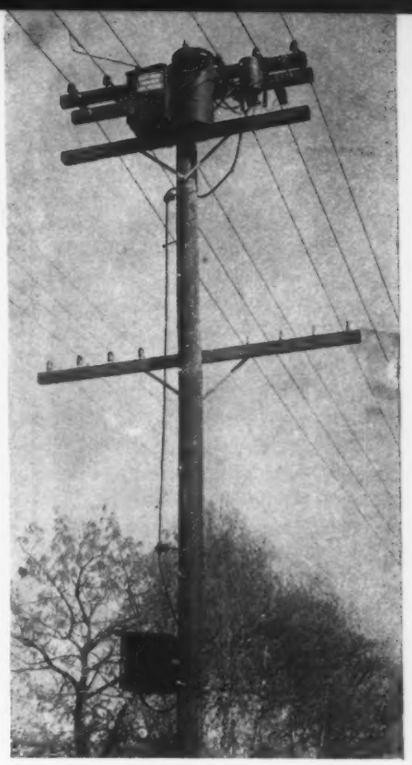


DEAD-END TRANSITION TO UNDERGROUND SIMPLIFIED

Typical dead-end pole in the territory of the New England Power system with 4-kv., three-phase, four-wire overhead circuit rebuilt from 2,300-volt line and equipped with solid blade, quick-break disconnecting switches, enabling either or both of two underground circuits to be fed or separated from this overhead supply. The line taps pass directly to the switches, which in turn connect with three single-phase potheads for each underground circuit. The latter is carried down the pole in 4-in. fiber conduit to a 4-in. iron pipe carried 10 ft. above ground for mechanical protection. Pothead spacing is 15 in. between phases. Neutral is grounded at substation, with no switch at pole. Climbing space is ample.

ONE-STEP BOOSTER ON A PHASE

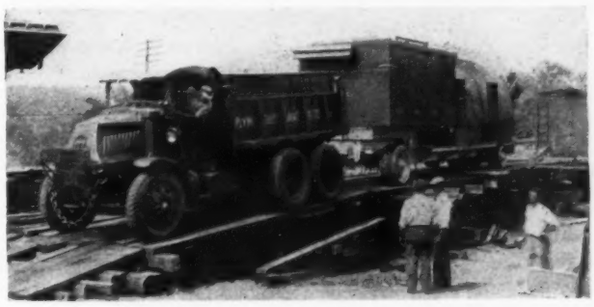
One-step booster for automatic raising of feeder voltage in the Clayville section of New England Power's Narragansett Electric Company system, near Providence, R. I. A 10-kva. transformer with relay cabinet welded to case and suspended from upper crossarm can be set to raise the primary voltage 5 to 10 per cent, as desired, in the event of low secondary potential. Booster connected across 2,400-volt phase of a four-wire, 4-kv. circuit with grounded neutral. Potential coil at right of booster and instrument box near ground installed for test purposes only.



PORTABLE CONDENSER AIDS CARRYING SEASONAL LOADS

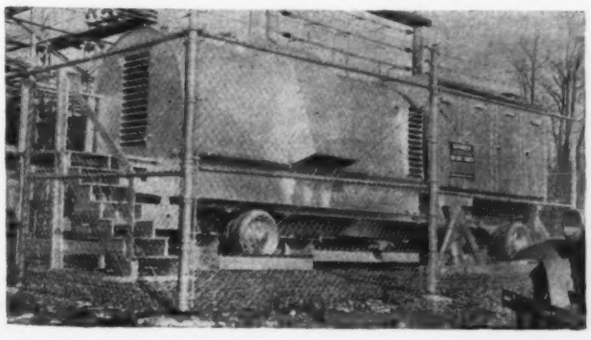
Heavy seasonal loads carried at different times of the year required synchronous condenser capacity at different points on the Pennsylvania Power & Light Company distribution system. This situation was effectively met at low cost by the use of a 2,500-kva. portable and automatic synchronous condenser. Permanent automatic condensers in these short-season load locations would have been uneconomical.

Installed in a resort territory during the summer months, the portable unit is transferred after Labor Day to any other part of the system needing voltage correction, this transfer being made by flat car or road haulage.



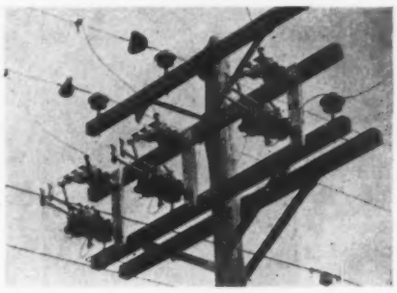
Portable Synchronous Condenser Remedies Voltage Conditions

Below, installed at substation; above, transferred to a flat car for shipment. Unit mounted on 35-ton heavy duty trailer. Rated for operation on 2,300 or 4,000 volts. Used with a 1,500-kva. transformer bank on 11 kv. Unit installed is 30x7½ ft.x11 ft. Equipment on trailer weighs 39,400 lb. Trailer weighs 13,000 lb.



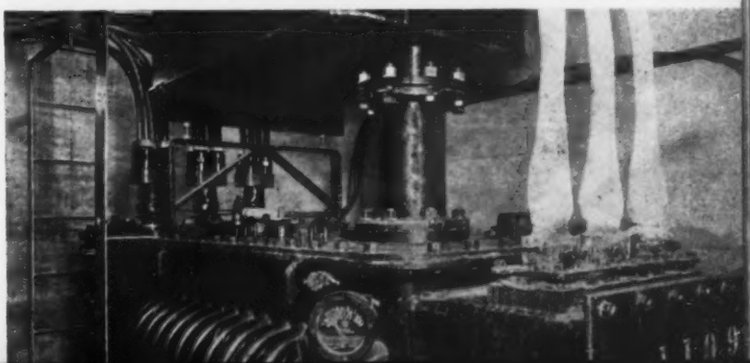
REPEATER FUSES

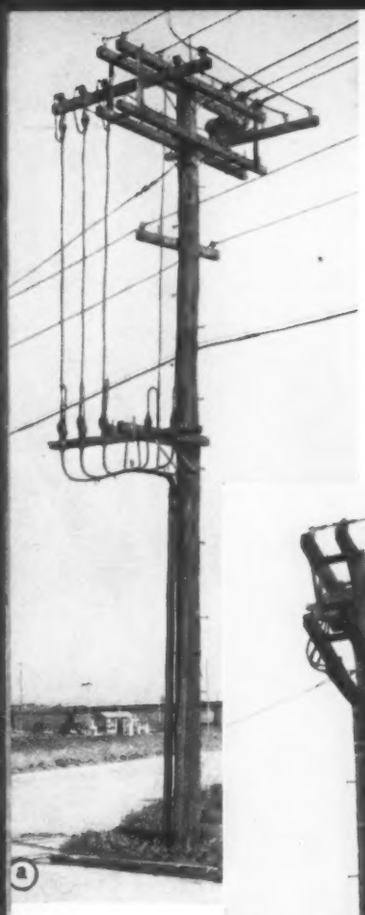
Three-shot fuses on 11-kv. rural branch of the Virginia Electric & Power Company.



UNDER-SIDEWALK VAULT HAS TANK FOR ARCING GASES

Typical network vault of Narragansett Electric Company (part of the New England Power Association) under sidewalk at Washington and Snow Streets, Providence, R. I., showing a 300-kva. transformer with 11-kv., 3-phase feeder cables terminating in switch cabinet at right, which permits grounding feeder, open-circuiting, or connection to the transformer primary by manual operation. Secondary 120/208-volt cables and network protector at extreme left.





Modernizing Underground Distribution Systems

Trend Toward More Economical Investment and Greater Convenience of Operation — Closer Scrutiny of Methods Features Current Practice

By T. H. HAINES

Superintendent of Transmission and Distribution, Boston Edison Company

IF WE REVIEW the developments of the recent years, there seems to be little doubt that the power industry has definitely entered into a new phase in its existence. We find that the old order, which was devoted to satisfying adequately the need for expansion, has yielded to the new, in which the emphasis is placed on consolidation of past gains, refinements of the art, and careful analysis of means for making future extensions at the least cost consistent with improved service reliability. In this process we are finding that underground distribution offers many opportunities for improvements in electrical layout, economies in constructional features and further advances in service dependability.

Interest in underground distribution centers primarily, of course, around the network, which is at once the oldest and newest of the electrical systems. Fifty years ago, before transmission lines and turbo-generators had been conceived, Thomas A. Edison devised the underground d.c. tube network, so successful and practical that many miles are still in regular operation. The successor of this system, the a.c. secondary network, has hardly yet come of age. Starting out ten or fifteen years ago along boldly original lines, we see it today assimilating certain elements from the older d.c. network, with the result that a splendid modern system of high dependability and low cost is now a reality. Only within the last year or two, for example, has fusing of the mains come to appear definitely advisable for the a.c. network. Note, however, that the massive and costly junction box has been left behind, and the fuses are being incorporated in the cable joints without noticeable effect on the size and cost of the underground structure. The joints themselves are showing a definite tendency to swing over into the solderless class, as typified by the crab joint shown in Fig. 1.

The expensive lead covering of the network cable may be omitted, if desired. If fuses are adopted, the non-explosive feature of the insulation will become a minor consideration. The simplified requirements for this cable have effected a reduction in cost.

Economies in Plant

Layout of the network does not even appear to have become definitely fixed as yet, when we observe a pilot wire loop feeder scheme such as used by Philadelphia showing splendid performance along with the more generally accepted New York type of network.

Network protectors while not yet successfully simplified and cheapened, have nevertheless been improved mechanically in important respects, and, together with the transformers are now compactly fitted into smaller manholes.

While the a.c. secondary and primary networks are now completing their

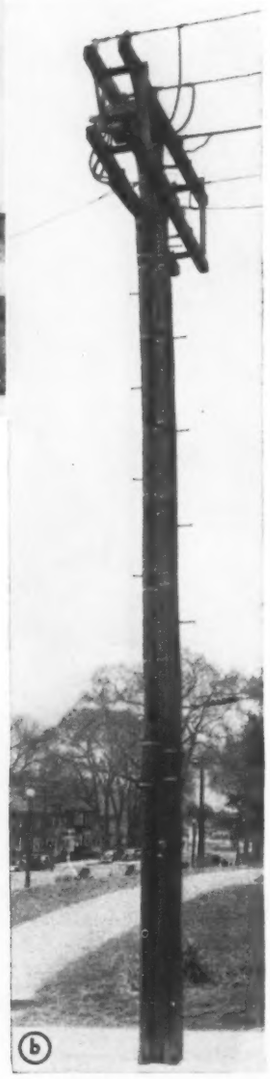


Fig. 2—Riser Construction (a) With (b) Without Potheads
In this construction the ozone-resisting rubber covering of the cable is provided with no mechanical protection other than a fiber guard beyond the point where it emerges from the lead sheath near the top of the pole. For stranded cables a water-break solderless connector is used at the connection to the line or to pole top apparatus, where moisture might find a point of ingress.

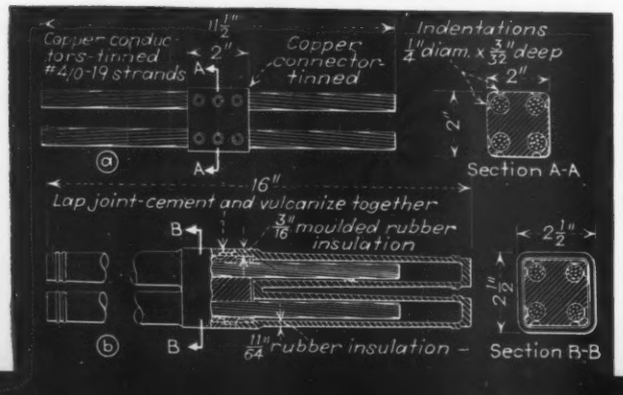


Fig. 1—Crab Joint (a) Before and (b) After Applying Insulation

first growth, the underground radial distribution system has passed through a period of intensive refinement. During the several years of urgent necessity for retrenchment and curtailment we find that new arts have arisen which enable future construction to be accomplished at lesser cost, and which point the way to economical modernization of existing plant during normal maintenance, and on special programs, as money can be made available. An outstanding example of such an advance is demonstrated by the history of primary riser construction. Until a few years ago the trend in this construction was definitely toward the use of potheads which terminate the lead-sheathed cables when they are brought up on the pole from the underground conduit systems. The industry was impelled toward the use of potheads because of the need for sealing paper-insulated cables against moisture, and rubber-insulated cables against ozone-cutting, at the termination of the lead sheath on the riser pole. As the pothead art evolved, it became an expensive construction, due to the increased complication of cap nuts and hood nuts required to seal the conductor strands against the entrance of moisture; the necessity for safe insulating coverings for the live parts, and the increased weight and size, with the resulting complication of crossarm construction necessary for support.

The development of ozone-resisting rubber-insulating compounds to a high degree of reliability, coupled with reasonable cost, has paved the way during the past few years for a reversion to the earliest form of riser construction, involving the complete elimination of potheads. A particular form of this construction adopted by the Boston Edison Company is shown in Figs. 2a and 2b.

The new construction has resulted in improved pole appearance, freedom from expensive maintenance cost incidental to the breakage of porcelain terminals, but, most important of all, the substantial reduction in first cost and in pole replacement costs of about 50 per cent. Some companies go so far as to omit the lead sheath from the primary riser cables all the way to the joint in the first manhole. On more than one system maintenance programs may be awaiting release in which pothead construction will be converted to potheadless construction. There are frequently numerous chipped or cracked potheads operating on the various systems which are not in imminent danger of electrical failure, and can therefore be tolerated until money becomes available for such maintenance work as is not in the emergency class.

Improved Sectionalizing

An example of desirable modernization in layout which has been developed on the Boston Edison system is a rearrangement of the subway oil switches for sectionalizing. Under the old scheme each subway transformer was provided with an individual oil switch and line sectionalizing switches were installed at various vantage points on the primary circuits. The new pattern which is being followed consists in the elimination of the transformer switch and the installation of a switch in the line between practically every transformer tap. This results in improved sectionalizing facilities, as shown in Fig. 3.

The most substantial improvement in recent years in the electrical engineering of the radial and primary network distribution on the Boston Edison system has been the adoption of the "balanced or rotated phases" arrangement, coupled with the use of lead sheaths for the grounded primary neutral. Originally the three-phase primary feeders terminated at the center of distribution and each phase continued separately in a different direction to serve a "phase area." Adoption of the grounded neutral permitted the use of the existing insulated neutral cable as a new phase conductor, the lead sheaths of all cables in the conduit system constituting the grounded neutral conductor. The load previously carried by one-phase in the "phase areas" was thus divided among two or three phases in the new arrangement, reducing the currents in all conductors including the neutral, and consequently improving the voltage regulation of the system to the point where additional load could be carried without difficulty. Introduction of the "balanced phases" scheme has successfully increased the capacity of the existing distribution circuits to the point where the construction of several new substations or primary network installations has been successfully delayed for a considerable time.

Fewer Transformer Manholes

Economic studies of underground distribution during the past few years have disclosed the fact that transformer vaults, containing several hundred kva. of transformer capacity designed to serve areas of moderate load density, such as the typical New England suburban square, and four to six-story apartment districts, are not economical, as had been supposed previously. This and the general practice of building separate transformer manholes communicating with the main duct run have consequently been abandoned, and more and smaller subway transformers are now being satisfactorily

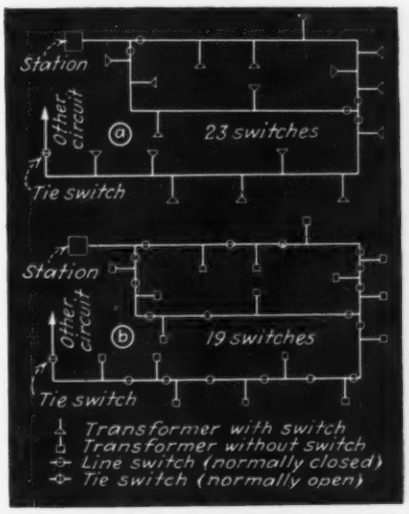
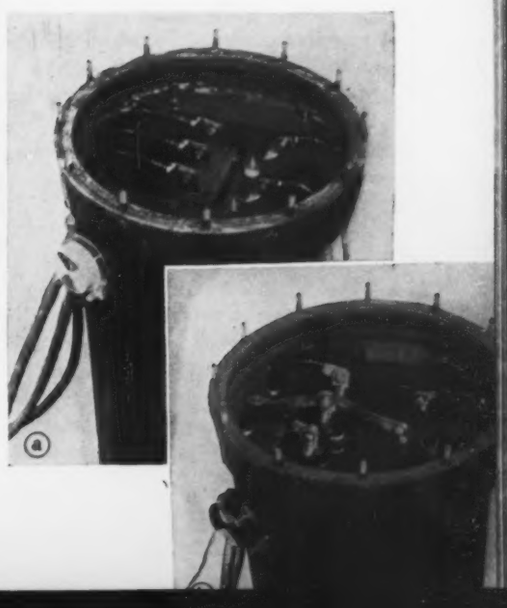


Fig. 3—Improved Sectionalization of Underground Primaries

This enables the troublemen to locate faults more quickly, and to restore service to a greater proportion of the affected customers, and yet reduces the net quantity and hence cost of switches installed.

Fig. 4—Reducing Transformer Leads From (a) Five to (b) Three

There are now two insulated secondary leads and one insulated primary lead. The primary neutral is carried to and through the secondary neutral terminal within the transformer and out through a stud in the case.



installed directly in the line manholes.

Introduction of the grounded primary neutral and the common primary and secondary neutral generally permits economies in distribution which are very substantial. In particular, the single-phase subway transformer (Fig. 4) may be fitted with three insulated leads and a bare neutral conductor, where five insulated leads were formerly used.

Such a fundamental unit of construction as the manhole cover has not been spared the careful consideration necessary to develop it to the most efficient condition possible. A new tread has been designed, with depressions too small (¾ inch on a side) to catch the heel of a woman's shoe (Fig. 5), and the plate has been made lighter without sacrifice of necessary strength.

Operating methods have come in for their share of analysis. A new scheme for assuring correct division of load between transformer banks operating in multiple consists in the application of wound silicon steel tapes to the transformer leads while the transformers are operating, and the division of current is observed and indicated by a special instrument designed to facilitate the task.

Improvements, simplifications and economies in plant construction too numerous to mention have been accomplished during these years. Statistical studies of system failures have indicated not only where improvements in reliability have been urgently necessary but, conversely, they have shown certain spots where high quality of construction was unwarranted. For example, no single failure of lead-covered secondary distribution cables over a considerable number of years was found to be definitely attributable to an inherent fault in the cable. The great majority of failures of these cables are caused by foreign interference, usually in the form of digging operations. These facts indicated that no hesitation should be felt in reducing the quality and thickness of the insulation and the thickness of the lead sheath. Substantial savings have been realized each year since this change was made, without any evident sacrifice of reliability.

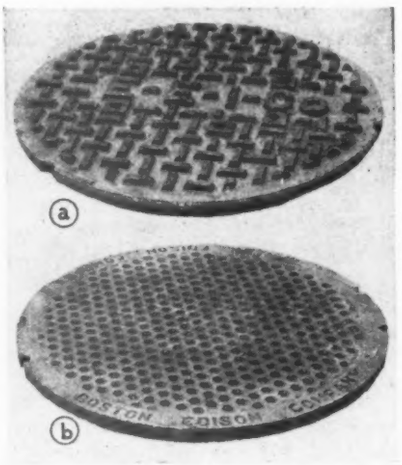
Buried Cable Usefulness Discussed

There has been much discussion of buried cable construction among distribution engineers. Foreign practice has frequently been cited to show that the American use of the duct system is unnecessarily expensive. Whenever this question has been carefully analyzed the conclusion has been reached that there is very little application for buried construction in this country. It appears, however, to have a practicable use in new residential developments where conductor sizes if properly chosen initially will seldom, if ever, require changing, and where transmission or primary cables are not to be included in the same route. In such locations, where the buried construction is applicable, voltage regulation, and not temperature, forms the load limitation, and a long term of service is to be expected without change in the system. Buried construction appears to hold little interest for distribution engineers, aside from special or experimental applications, such as one in which the Boston Edison Company recently installed a 5-mile section of 5-kv. buried primary cable for emergency throw-over supply to an important load in a suburban section.

A very recent development which may prove to be of considerable benefit is the common use, in new private property construction, of a single trench for more than one utility service, such as electricity and telephone. Earnest co-operative effort will doubtless evolve some economical improvement in the near future over the present practices.

Many improvements in underground distribution appear to be "just around the corner," some of them of a fundamental nature. Investigation of the possibilities of the auto-transformer for single-phase subway use may turn out to be profitable. Non-leaded cable construction and solderless connections appear to be definitely on the increase.

Fig. 5—Older Type of Manhole Cover (a) Superseded in Later Construction by Design (b)



Subway distribution transformers may be fused more generally, either externally or internally, and this practice will undoubtedly be extended when more satisfactory subway fuses become available.

The old practice of installing separate single-phase and three-phase secondary mains for lighting and power loads, respectively, is being reconsidered, and a definite trend is under way toward the use of combined lighting and power secondaries, consisting either in a four-wire star system or a four-wire delta system with the ground applied at the mid-point of one leg.

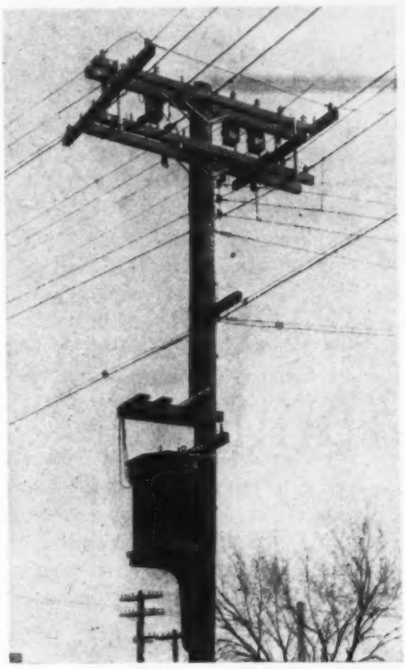
Insulated or Grounded Neutral

A moot question, apparently no nearer positive solution now than formerly, is the question of the relative merit of the insulated neutral and the grounded neutral primary system, although the trend seems to be toward grounding the neutral. The former gives better service continuity, theoretically, while the latter is less expensive. On the Boston system, where the change was made from ungrounded to grounded neutral operation and coincidently to common neutral operation, an improvement in reliability was experienced in the overhead neutral distribution due to simplification of the pole top and generally better spacing between wires, which more than offset the somewhat poorer operation of the underground distribution, where practically every insulation failure now produces an outage. However, the savings in line and substation construction costs alone afford ample justification for the change.

It should be recognized that, throughout these years of development and improvement, service continuity and regulation is always stressed by the designer and the operator. The troublemen, trouble despatchers and maintenance supervisors are schooled, from their first days of employment, in the prime importance of keeping the load energized. That no expense is too great and no work too laborious when customer outage is involved has been the tradition of the industry, almost to too great an extreme in occasional cases. However, this policy is believed to have been amply justified by the increasing dependence which the public places upon the supply company, which is evidenced by the steady increase in "all-electric" homes. The average underground distribution system renders a service usually more than 99.995 per cent continuous.

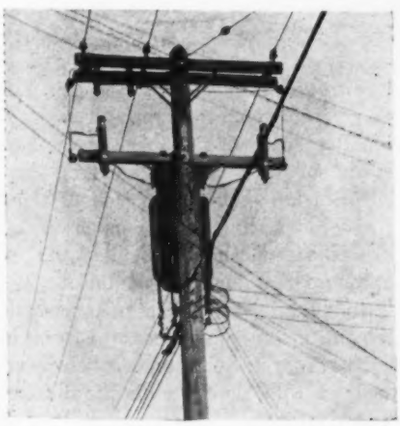
TRANSFORMER PLACED ON BRACKET

Simplified construction on typical Boston Edison distribution pole in Woburn, carrying 75-kva. transformer on bracket, with primary and secondary leads close to the pole. Primaries (4,160 volts) are of ozone-resisting rubber in fiber U-guard. Secondaries are of three-conductor cable with special hard braid covering attached

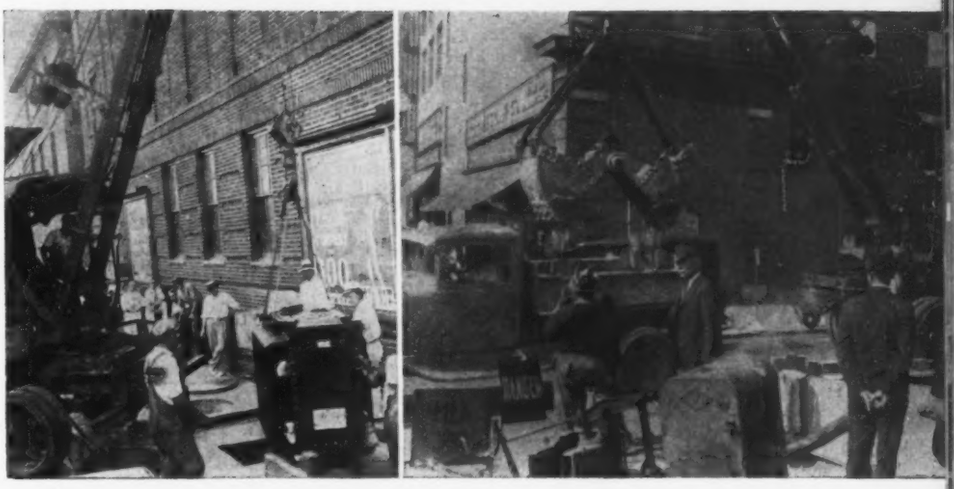


to pole by rubber bushings and pipe clips. Primary fused cut-outs and lightning arresters at pole top. Platform above transformer is used by telephone maintenance men.

SECONDARIES BUNCHED



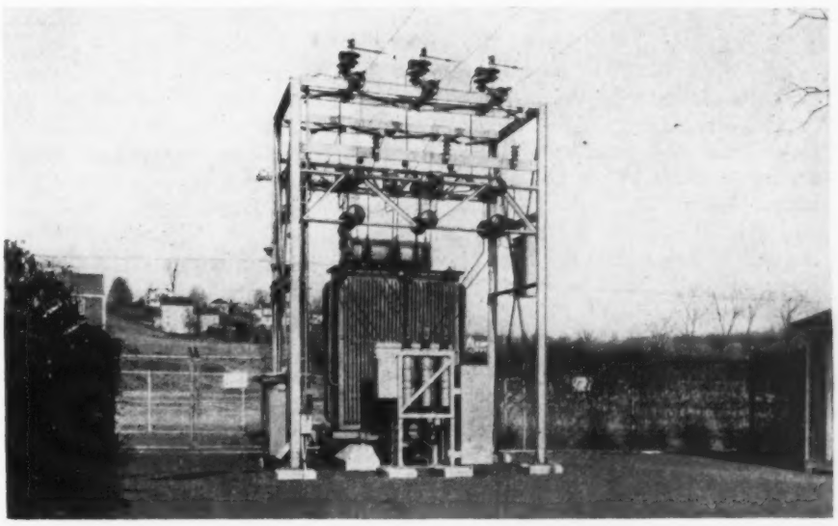
To save pole space, reduce impedance losses and use where open wire construction may be objectionable as regards appearance, bunching secondary conductors on a messenger cable is becoming common. Here is an alley scene in Detroit, bunched secondaries on the right, open construction on vertical racks at the left.



AIR CONDITIONING PROMPTS SECONDARY NETWORK

Increasing loads (due largely to air conditioning) made a secondary network a logical improvement for the Norfolk and Richmond areas of Virginia Electric & Power. Non-leaded cable in Richmond secondary network crane and power excavator expedites work on underground and helps public relations and traffic.

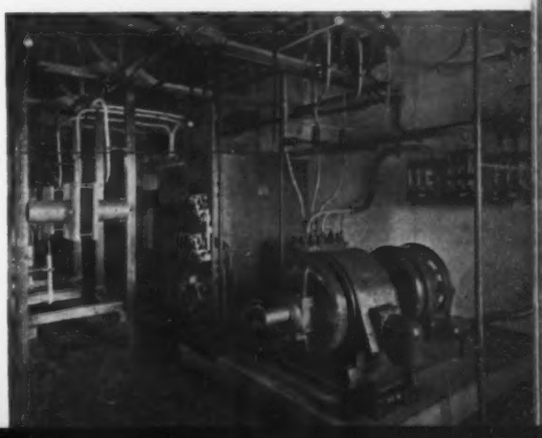
SUBSTATIONS REPLACE LONG PRIMARIES

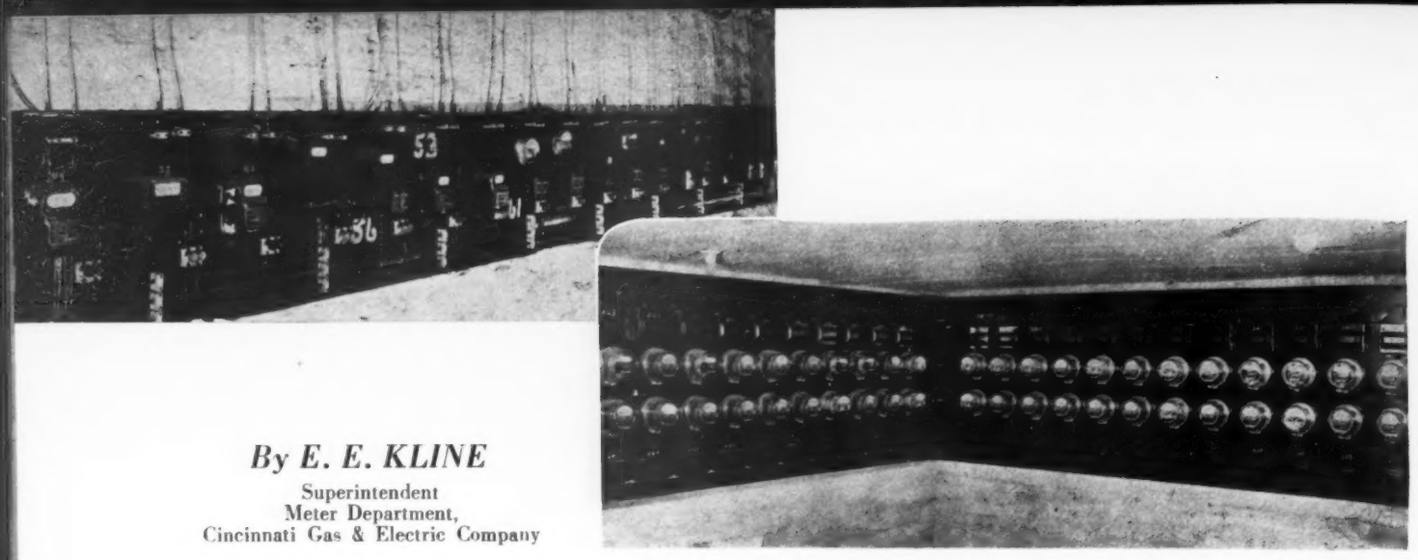


Characteristic practice of the Connecticut Light & Power Company in replacing long runs of 2.3-kv. and 4.6-kv. circuits from a larger central installation. Smaller substations at load centers facilitate local regulation of voltage and afford reliable service. Many such units are landscaped with trees and shrubs to harmonize in appearance with their residential surroundings.

PUSHING ONE BUTTON LIGHTS SPRINGFIELD'S STREETS

Eighty-three per cent of the 4,257 street lights of Springfield, Mass., are now turned on and off by carrier current. To insure continuous operation at all times the United Electric Light Company has two duplicate control transmitter sets at different locations comprising motor-generator with coupling reactors, capacitor housing, insulating transformer, protective gaps and control panel. The frequency is 720 cycles.





By E. E. KLINE
Superintendent
Meter Department,
Cincinnati Gas & Electric Company

Modernization of Metering and Services an Opportunity

AS A RESULT of the depressed conditions in the past eight years many utilities have curtailed their modernization of customer service facilities to an absolute minimum. Many old open-wire services still exist throughout the country and in many cases meters have been scrapped only because repair parts could no longer be obtained.

Yet the past eight years have witnessed a very rapid advance in the development of service equipment. Service-entrance cable, outdoor installations, meters with complete temperature compensation, high overload capacity, provisions for stroboscopic testing, the standardized "A" and "S" bases, improved bearings, all are comparatively recent developments. And there are still more developments in sight. We are only beginning to realize the potentialities of the new, compact, polyphase meters.

As a result of this situation, there exists in the utility field an opportunity for the modernization of service and metering facilities.

Enlarging Service Capacity

Until a few years ago utilities based their residence service facilities on the actual load requirements of their customers. However, the widespread use of electric refrigerators has necessitated a radical revision of this policy. Satisfactory service now demands facilities adequate to prevent any light flicker due to refrigerator starting and running current fluctuations. As a result, there is an urgent need for the modernization of all secondary circuit capacity.

The basic problem is to reduce the secondary circuit impedance sufficiently so that the voltage fluctuations resulting from the current fluctuations are too small to cause lighting flicker. There are a number of things which should be done to accomplish this. In the first place the size and spacing of the distribution transformers must be adjusted to reduce the effective transformer impedance to a minimum. It may be possible to utilize auto-transformers to improve the voltage at the end of long lines. Secondly, the wire size of the secondary distribution circuits should be increased to No. 2 or larger. Third, the customers' service drops should be no smaller than No. 8, and larger if large appliances are used. And fourth, the company should encourage the customer to install three-wire service with adequate capacity for all requirements. In fact, one of the best ways to solve the flicker problem is to provide three-wire service so that the lighting circuits can be connected on one side of the service and the motor-driven appliances on the other side.

Through such a modernization program a utility can render the most satisfactory service to its customers.

Modern Meters—The normal load range in the average home at the present time may vary from a very small night load of clocks and night lights to the relatively heavy appliance loads. To cover this wide range of load conditions accurately requires a modern meter; the older meters, with narrower capacity limits, will run slow at both lower and higher ends of the range, with corresponding loss of revenue.

Wide Accuracy Range

Furthermore, the wide accuracy range of modern meters means a smaller stock of sizes and more flexibility in installation. In fact, some utilities have gone so far as to standardize on a single size of meter for all residence metering, with all of the advantages that this plan implies.

In the matter of maintenance, the modern meters offer many opportunities for savings in operating costs. Modern meters, with their standardized bases, can be installed or removed much more easily and quickly than the older meters. They are easier to repair and test. And they permit the application of stroboscopic testing in the shop, which results in large reductions in test costs.

Also, the improved durability and reliability of the new meters permit field test periods to be increased, with corresponding reductions in test costs. It is the opinion of metermen that present-day "periods between field tests" could be greatly increased with modern meters.

Outdoor Metering

The outdoor meter has opened a wide range of interesting possibilities. Not only is outdoor metering one of the best solutions to the tampering problem, but also it is a complete solution to the problem of locked-out meter readers. This problem is particularly important in rural territories, where a return call is relatively expensive. In many cases a wholesale change-over to outdoor metering can be economically justified. Outdoor metering is undoubtedly the best solution to the metering problem in rural electrification programs.

Where conditions justify, such a program may be co-ordinated with the installation of circuit breakers instead of fuses for the protection of customers' services in order to reduce expensive service calls.

Yet, very few companies have found themselves in a position to invest in any extensive modernization program. In many cases the use of these new developments has been restricted to new installations and to the most flagrant tamper cases.

In planning a modernization program for metering and service facilities it is advisable to co-ordinate this program with the obsolescence program so that the new meters progressively replace the older types of meters. If a complete change-over program is planned it may be advisable to change over some of the newer compensated meters to the new socket bases, or to install them in metal inclosures.

Prevention of Tampering—One of the most important factors in favor of modernization programs is the prevention of tampering. The National Electrical Code revision permitting meters to be connected ahead of the service switch and fuses in combination with the development of metal-inclosed metering equipment has resulted in practically tamper-proof installations. It has been definitely shown* that the prevention of tampering alone, by the resulting increase in revenue, is sufficient in most cases to justify a utility in making the investment to change over the installations, where tampering is suspected, to the new metal-inclosed new-sequence services. In certain territories where tampering is particularly prevalent a complete wholesale change-over to new sequence installations may be justified. In such cases service-entrance cable can be used to modernize and tamper-proof a service in a single operation. In considering this tamper problem it is important to remember that there is not only the question of preventing theft of energy but also one of more equitably distributing the charges of electric service with the resultant benefit to customers.

Applications in Commercial Metering—So far the discussion has pertained largely to residence metering. However, the commercial metering field also offers many opportunities for profitable investment. The accurate determination of demand improves the equity of charges for electric service. The increased reliability of the newer demand registers offers an excellent opportunity for more companies to extend their demand metering down to the smaller commercial customers with a corresponding reduction in complaints and improvement in customer relations.

The newly developed cumulative demand registers offer the advantage of providing permanent records of demands. In many cases, particularly isolated installations where maintenance is difficult and expensive, thermal meters may be the best solution for demand metering.

Potentialities of the new, lightweight, polyphase meters have yet to be fully realized. The small size, light weight, and improved performance of these meters offer exceptional opportunities for the modernization of old commercial metering installations.

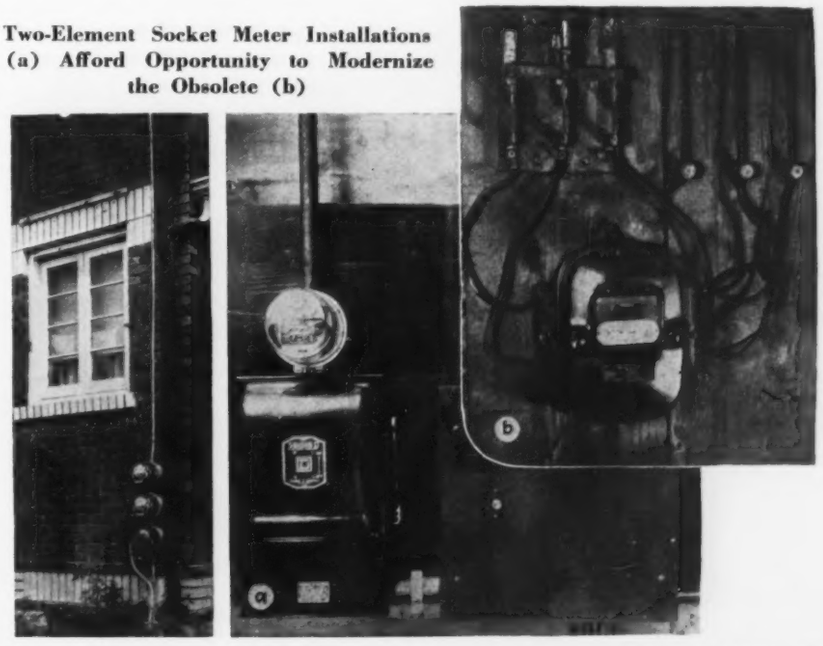
Effect of Rate Structure—A good rate structure should offer inducements to the customer to co-operate in improving his load factor and power factor in order that the utility may use its existing equipment to the greatest advantage. These rates may take the form of off-peak hourly periods for water heating and other uses. Or they may be special off-peak seasonal rates for air conditioning and ice making for improvement of the system load factor. Then, again, power-factor clauses or kilovolt-ampere rates may be used to induce customers to use synchronous rather than induction equipment in order to improve their power factor.

The institution of any of these special rates would entail a considerable outlay for new metering equipment, but the long-range advantage of such a program would far outweigh the initial cost.

Modern Test Meters

In discussing the value of new equipment, it might be well to point out also that new test meters are becoming in-

Two-Element Socket Meter Installations (a) Afford Opportunity to Modernize the Obsolete (b)



*"Effective Ways to Stop Energy Diversion," ELECTRICAL WORLD, October 12, 1935, by E. E. Kline.

Off-Peak Metering of Water Heating Improves System Load Factor (Right)

creasingly important. In the past, many utilities have been clinging to their old test meters, possibly on the theory that uncompensated customers' meters and uncompensated test meters will vary, together with temperature, and eliminate the temperature error. It has been shown* that as the proportion of temperature-compensated meters in service increases the temperature errors resulting in actual loss of revenue become proportionally more prevalent. Thus, there is the direct factor of actual savings as well as the indirect factor of improved performance in the use of the modern types of test meters, which could be realized if the utilities were in a position to replace their old, uncompensated test meters.

Telemetering and Totalizing—Where more than one generating station or a combination of generating stations and interconnections supply a utility system, the individual and simultaneous combined loads can be obtained at a centralized location, such as a load dispatcher's office, by means of telemetering and totalizing metering equipment now available.

Even though such equipment is expensive, there are many places where such modern aids to system operation and economy can be justified.

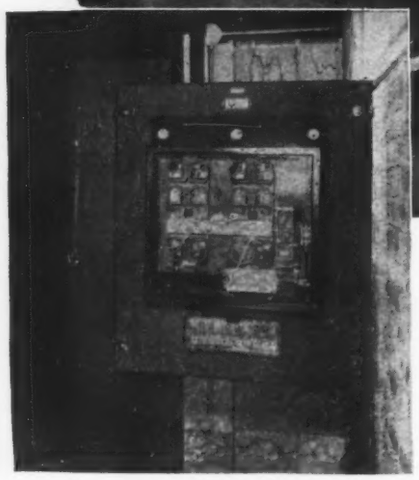
Protection of Equipment in Flood Areas—Immediately following major catastrophes, such as floods, large expenditures are required to repair equipment and property damage and to replace equipment damaged beyond repair so that normal service can be restored as quickly as possible at a time when it is needed most. It is a widely known fact that electrical utilities are leaders in rehabilitation at such times of emergency. In some cases, particularly in the case of floods, which are generally recurrent and give some warning of their coming, it is possible to employ an economical degree of damage prevention.

Unprecedented floods were experienced during the past two years in several sections of the country. These necessitated vast expenditures for replacement of lost and damaged equipment, and also investments in "flood-proofing" measures to protect against the newly established "maximum flood stages."

An ideal protection against flood in so far as meters are concerned is to place them above maximum flood level wherever feasible, or to install only the quickly removable types of modern meters (outdoor if possible) in the flood districts to facilitate the gathering-in of this equipment as the waters rise. Obviously, reconstruction of customers' installations to utilize these methods cannot be done with expense to the customer. The entire burden must be borne by the utility, and this is impossible unless ample funds for investment are at hand.

*"That Old Test Meter Is Losing Money for You," by Royce E. Johnson, ELECTRICAL WORLD, February 13, 1937.

Stroboscopic Testing Cuts Test Costs With Modern Meters



Kva. Metering Encourages Customer Improvement of Power Factor

Records and Meter Movements Reducible

During recent years the development in improved filing systems and record-keeping methods has provided many opportunities for modernization of service and metering equipment inventory records and record-keeping practices. Many companies are still using the same systems they started with, although their plants have long since outgrown such antique methods. The recent requirements for inventory and valuation data have caused some of the older record systems to become inadequate to carry the increased burden of requisite information.

Under reduced purchasing budgets, it becomes difficult to maintain adequate working stocks of meters of the requisite sizes and types without resorting to the reduction or the entire discontinuance of the period meters are permitted to remain idle on premises. As a consequence, some increase in operating expenses for meter movement and a corresponding decrease in efficiency of response to "cut-in" orders is unavoidable.

The ideal situation would be one where the regular purchases of new meters to take care of new business and replacements be continuous. This would permit meters to remain installed at all times at tenantable locations on the system.

NEW SEQUENCE DETACHABLE ADVANTAGEOUS

By J. C. LANGDELL
Commonwealth & Southern Corporation, Jackson, Mich.

An experience of about seven years with the new sequence and four years with the detachable meter indicates to us that such a practice has the following advantages:

1. It provides a means of standardization of installation in view of the fact that all manufacturers now manufacture a meter that can be installed in the same socket.
2. It provides means whereby we can conveniently test and read without any inconvenience to customer whatsoever.
3. It unquestionably provides a method which minimizes current diversion to a very large extent.
4. It provides a compact, standard means of protecting unmetered parts when in any case it is desired to remove the meter.

The second step in standardization concerns a fifteen-year or longer-life bearing. About 90 per cent of our meter errors seem to have been caused by breakdown of the lower bearing. We have concluded to standardize on the ball bearing with better prospect of all-around meter performance and lower operating maintenance costs.

Also, we have practically standardized on the 15 amp. single-phase meter, most of the new meters being three-wire.

Lightning disturbances on 480-volt, three-phase ungrounded power distribution secondaries had caused excessive burn-out of the self-contained meters. Bakelite terminal chambers made the problem more acute and it was met by the now available meter protector. Present troubles are not considered particularly burdensome. The customer's utilization equipment and the distribution system itself benefit somewhat.

OUTDOOR SOCKET METERS ADOPTED

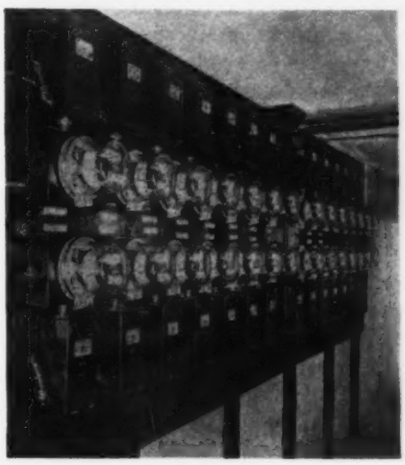
By E. S. FITZ
General Manager Electric Department, Virginia Electric & Power Co., Richmond, Va.

Practically all of our new meters for residences are socket type, with no fuses, or switches ahead of the meter. Wherever possible, meters are located outdoors. We prefer the outdoor type of metering because we save much time in meter reading and testing; also there is much less chance for theft of current. We recommend service-entrance cable of bare neutral type. Three-conductor services are desired wherever possible. We have adopted a combination meter and time switch to be used in connection with our time-control water-heating service. This meter practically matches the ordinary residential meter and the two units make a very satisfactory installation—much better, in fact, than two meters plus the time switch.

Four-Apartment Meters Second Has Time-Switch for Water Heating

COMPACT METER PANEL FOR APARTMENT HOUSE

Formerly a hospital, a Union Avenue 27-apartment building on the Boston Edison system at Framingham, Mass., is served by a compact meter board mounted in a former underground passage. Three



500,000-circ.mil cables are carried in duct to the center of the board, where they drop vertically toward the bottom, horizontal buses of the same size being carried in troughs behind 15-amp. socket meters from which connections are made to the service switches and risers feeding the several tenants' quarters. Each apartment is provided with an electric range.

APARTMENT RANGE CONSUMPTION TOTALIZED

Central control board for totalized metering of energy consumption of 241 electric ranges with 1,678 kw. connected load at Longwood Towers apartment hotel, Brookline, Mass. Rentals include electricity for cooking. Type "SCF" three conductor Anaconda service entrance cable connects the terminal boxes in the basement with the range receptacles. Typical dead-front distribution cabinets control and fuse individual range circuits, one per apartment.

DIVERSION 90% CURED

By A. H. KREUL
Asst. Supt. E. M. & C. Department, Portland (Ore.) General Electric Co.

New socket type meters and time clock on lighting, range and water heater service — Light originally indoors, entrance at upper left. Later range meter installed indoors. Water heater service combined on two meters with time clock of socket type.

With the approval of the new sequence method of metering our company immediately began to remove old meters from indoor locations and replace them with modern meters installed on the outside of residences.

The program was initiated primarily for the purpose of preventing diversion of current, but it was only a short time before outdoor locations began to become popular with customers, and especially with our meter reading and billing departments. Customers are now making more requests for outdoor locations than can be handled. It is our estimate that new sequence metering is permanently curing 90 per cent of attempts to divert electric current.

At present about 25 per cent of our meters have been moved to outdoor locations, and, if funds are available, we plan to make the change on our entire system.

TELEMETERING AND TOTALIZING EQUIPMENT

System operators of Philadelphia Electric Company utilize telemetering and totalizing equipment as guide for faster load dispatching.

Leeds & Northrup Co.

Fig. 1 — Seven-Man Cab for New Heavy Line Truck

(a) Bus type door, conveniently accessible compartments and general pleasing appearance.

(b) Wide platform space and accessibility of ropes, digging tools, derrick, etc.

Attractive Economies in Standardized Transportation

By J. R. NORTH
General Technical Engineer
Commonwealth & Southern Corporation,
Jackson, Mich.

COST-CONSCIOUS electric utility companies have turned the spotlight on transportation equipment and effected savings of many thousands of dollars in the purchase and operation of their transportation fleets.

For years utility companies have striven tirelessly to get more kilowatt-hours out of a ton of coal, but gave insufficient thought to transportation equipment. Truck application and design was often left to persons outside the industry, with the result that vehicles were often heavier than necessary or ill-adapted to their purposes. Here's what happened when a group of properties turned toward its automotive problems the same sort of scientific skill and determination which had achieved so much in other phases of electric generation, transmission and distribution.

With a fleet operating over a considerable area, each department and each division often has had individual ideas as to the type and size of passenger car and truck equipment required. The selection of equipment based almost entirely on manufacturers' recommendations, has been common practice in the past. In the case of trucks, this generally resulted in the purchase of over-size (and sometimes under-powered) equipment in view of customary allowances for overloads as in the more familiar transport service. Furthermore, the designs of bodies have differed widely in different areas. The body construction has been generally a composite of wood and steel, resulting in heavy units, although the net pay load ability was not correspondingly large. As a result, the fleets contained expensive equipment with relatively high operating, maintenance and depreciation costs.

It is not always realized how large an investment is represented by a fleet such as that of this operating group, where 2,500 cars, trucks and auxiliary units represent an investment of more than $4,000,000 (not including garages and service buildings) and an annual operating cost of more than $1,000,000. In the operation of such a fleet a relatively small saving per mile amounts to a considerable sum of money in the aggregate. For example, 2,500 vehicles traveling annually an average of 12,000 miles each produce a total of 30,000,000 miles per year. A saving of even 0.1 cent per mile would amount to $30,000 annually.

Study of the Problem

Recognizing the developments made in automotive equipment and the savings which might be obtained, it was decided several years ago to make engineering analyses and economic studies of the fleets of the associated companies. These studies were made jointly with the operating companies and included:

1. Analyses of the requirements as determined by the use of the various types of equipment—load weights, body arrangements, job analyses, engine and chassis performance, etc.
2. Determination of the types of bodies and auxiliary equipment best suited to meet the requirements.
3. Evaluation of existing transportation equipment as to adaptability and economical operation.
4. Selection of and standardization of equipment which would be most suitable and which would operate at the minimum total expense, including both operating costs and fixed charges over the life of the vehicle. This included the development of application guides and purchase specifications for chassis, bodies and auxiliary equipment.
5. Improvement of operating practices.
6. Improvement of maintenance practices.

The first step in this study was to find out just how the various types of vehicles were actually used in service and what auxiliary equipment and other facilities were necessary. Studies

were made of various field operations in the different areas. Discussions were held with those responsible for the construction, operation and maintenance work, and also with those in charge of the operation of the vehicles. The following gives a general classification of the vehicles used by many public utilities, according to their service, type of body, etc.:

Classification of Vehicles

Passenger cars.
Line Construction and Maintenance Trucks:
- Light construction and maintenance—overhead, underground.
- Heavy construction and maintenance—overhead, underground.
- Pole hole digger.
- Underground cable installation and maintenance.
- Tree trimming.

Customer Service Cars and Trucks:
- Service connection, meter installation.
- Complaints, trouble and emergency.
- Appliance repair.

General Maintenance Trucks:
- Station inspection and maintenance.
- Line patrol.
- Special testing.
- Street light and sign maintenance.

Equipment and Material Hauling Trucks:
- Heavy equipment hauling.
- Plant construction.
- Appliance delivery.
- General hauling of materials.

Miscellaneous Vehicles:
- Excavation and dump trucks.
- Pole trailers.
- Heavy equipment trailers.
- Caterpillar type tractors.
- Compressors, pumps, etc.

In analyzing the job requirements, it was often found that excessive quantities of storeroom materials had accumulated on the trucks, often overloading them and rendering an orderly arrangement difficult. Consequently, inventories were made by completely emptying typical line trucks, service trucks, etc., and sorting the tools, bin material and equipment into two groups, one which would normally be useful and active and the other group excess or obsolete material which belonged in the storeroom. Typical loading diagrams were subsequently prepared for the line and service trucks, showing the approximate quantity of tools and materials generally found necessary and their location in the bins and compartments especially designed for them (Fig. 1).

Line construction and maintenance crews range from three to seven or more men and they must be transported to and from the jobs during all kinds of weather. Some companies, particularly in the metropolitan areas, have the men report at the job or provide passenger car types of vehicles for transportation. In other areas the crew generally rides on the truck. This often presents many hazards, and in the northern climates during the winter lost time may result when the men are chilled on arrival at the job. Effective use of the platform space in the body for construction materials, in addition to greater safety and a more efficient crew, is obtained by providing a five- or seven-man cab specifically designed for the entire crew (Fig. 1).

Standardization of Equipment

Various types and sizes of trucks have been used for each of the service classifications listed, but when the specific requirements are thoroughly analyzed it may be found that by the proper selection of chassis and bodies a relatively small number of individual types will actually serve all purposes. A grouping of use requirements which is adequate but economical follows:

(a) Passenger cars.
(b) Line construction and maintenance trucks—overhead, underground.
(c) Customer service and meter trucks.
(d) Station maintenance trucks.
(e) Equipment hauling trucks.
(f) Miscellaneous—Pole hole digger, tree trimming, trailers, etc.

In determining the types of cars, truck chassis, bodies and auxiliary equipment best suited to meet the requirements, preference is given to the use of manufacturers' standard equipment wherever applicable because of its inherently lower first cost and better trade-in value.

Passenger Cars—In the past, fleets often contained numerous passenger cars in the heavier $1,200 to $1,800 class. Many improvements have been made in all classes of automobiles during recent years and, while the higher-priced cars may give a longer life in terms of mile-years, still the operating costs and depreciation are greater than with the lighter-weight, lower-priced cars. Careful analyses indicate that it is generally more economical to purchase cars in the $800 group and to retire them sooner. The so-called "Standard" models give more economical transportation than the "DeLuxe" models.

Truck Bodies—Certain classes of work, such as overhead or underground line construction, some forms of customer's services, etc., necessitate the use of special truck bodies for the regular carrying of tools and storeroom materials and to permit the proper installation of auxiliary equipment such as winches, pole derricks, etc. Therefore, body layout draw-

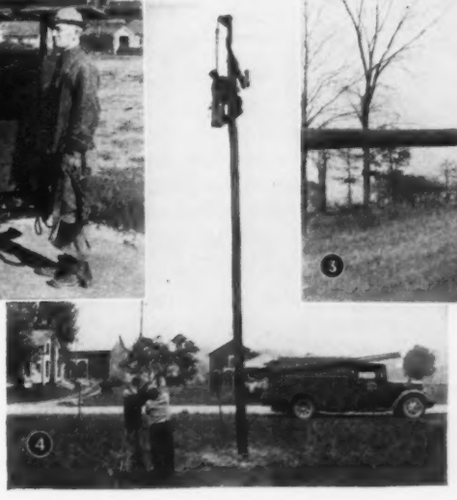
Fig. 4—Hanging a Transformer in Rural Area—Gin Pole Extension Used for Hoisting Transformer Safely

Fig. 2—General Service and Meter Installation Truck

Meter trays, bins, hot stock compartment, open body space for carrying transformers, wire, appliances, etc.

Fig. 3—Pole-Hole Digger Truck in Operation at Location Off the Highway

Note ease of carrying pole from road back to location and compactness of truck.



ings and specifications have been prepared for all-metal bodies for these purposes which can be mounted on chassis of various manufacture. These truck body layouts are designed on the basis of actual field requirements and were soon adopted as standard by the various associated operating companies, as well as by other companies throughout the country who appreciate their adaptability. This standardization enables the equipment to be purchased completely equipped and ready to be placed in service, at considerable savings in cost. These standardized units present a uniform appearance and permit greater flexibility of use than the former dissimilar units.

The new standard designs of all-metal bodies are much more efficient in actual use due to their compact arrangement, low floor levels and conveniently located auxiliary equipment and accessories. The bins are especially designed to carry the tools and supplies normally required (standard inventory list) and little room is left in the compartments for surplus materials. These bodies may be mounted on lighter-weight chassis, thus effecting an appreciable reduction in the total gross vehicle weight.

Line Construction Trucks—The line construction trucks of new design generally fall in the 11,000 to 14,000 lb. gross vehicle weight classifications with crew accommodations, special all-metal bodies having built-in compartments specifically designed for carrying the necessary storeroom materials, tools and hardware, and with adequate platform space for the construction equipment and material. Winches, pole derricks and other auxiliary equipment are necessary for the proper handling of the construction work. The savings in weight and initial costs are illustrated in the accompanying table.

Comparison of Overhead Line Truck Weights and Costs

	Weights–New Designs "Light"	Weights–New Designs "Heavy"	Weights Old Design
Body and cab	2,200 lb.	2,800 lb.	3,900+lb.
Auxiliary equip. and accessories	1,700 lb.	1,800 lb.	1,800 lb.
Tools and bin material	1,400 lb.	1,500 lb.	2,000 lb.
Construction material	1,000–1,500+lb.	1,500–2,500+lb.	1,500–2,500+lb.
Crew and driver	800± lb.	1,000± lb.	1,000± lb.
Chassis (approx.)	3,600 lb.	4,400 lb.	5,500 lb.
Average total weight	11,000 lb.	13,500 lb.	16,000 lb. & up
Average total cost completely equipped	$2,000–2,500	$3,500–4,000	$5,000 & up

Customer Service Trucks—Almost every conceivable type of body and chassis has been used at one time or another for customer service work. These units served for a variety of purposes, including customer service connections, meter installation, complaints, emergency work and for appliance repair. Such vehicles must present a neat appearance, since they are used in direct dealings with the customer. It has been found that light-weight units with suitably designed bodies are convenient for this service and economical to operate. At the present time the majority consist of ½-ton trucks with either open pick-up bodies or box compartments.

Material-Hauling Trucks—Many of the older trucks used for heavy equipment and material hauling were unduly large and heavy, due, probably, to the idea that they should be capable of transporting the largest single piece of equipment on the system. It was found to be far more economical to transport exceptionally heavy apparatus which is moved but infrequently by means of a four-wheel trailer, or to contract such infrequent hauling with an outside concern. Consequently, the old, heavy, slow-moving platform trucks were scheduled for gradual retirement. Where replacements are necessary, they consist of platform trucks having gross vehicle weight ratings of 13,000 to 18,000 lb., often with winch equipment.

Standard 1½-ton "stake" body trucks are widely used for hauling storeroom supplies, construction materials and miscellaneous equipment.

Pole Hole Diggers—With the wide development of rural line extension programs, the matter of trucks and auxiliary equipment for such work became of increasing interest. Earth-boring machines mounted on short wheelbase, light-weight trucks with "high traction" tires proved to be very effective for rural line construction as well as for the construction of wood-pole transmission lines. In areas where the tractive conditions are unusually severe light-weight four-wheel drive conversion units are supplied.

Tires—It was found that a very wide assortment of tires was being utilized—solid, high pressure and balloon. Experience with balloon tires on one of the properties had indicated that they were preferable to high-pressure tires due to their greater cushioning ability, traction and all-around tire performance. Consequently, balloon tires have been adopted for general use on all vehicles.

Maintenance Practices

Preventive maintenance rather than "repair after failure" is decidedly worth while in all types of fleet operations. Road failures of fleet vehicles, especially breakdowns of truck equipment, are oftentimes exceedingly costly, since not only is an expensive crew tied up, but customers' service may be seriously affected.

There are a number of workable preventive maintenance methods, schedules and record forms. Conditions vary with different fleets, and the proper one to use depends upon a number of items, including: Size and type of fleet; operation—mileage, loads, personnel; maintenance facilities available in the area; area covered, etc.

In analyzing the various maintenance schedules which were already available for use, it appeared that, from our standpoint, most of them were entirely too complicated and involved keeping too many detailed records. With the conviction, however, that a uniform system of preventive maintenance should be followed in those areas where such did not already exist, a simple but effective system was set up to include the following:

(a) Driver to be responsible for reporting current operating difficulties.
(b) Monthly lubrication (approx. 1,000 miles).
(c) Bimonthly inspection and road test (approx. 2,000 miles).
(d) Semi-annual general inspection (approx. 5,000 miles).

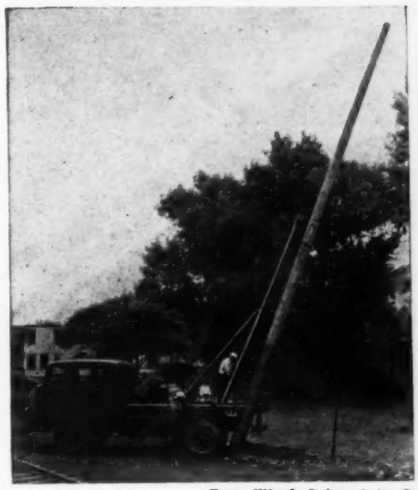
Competently trained garage personnel is necessary for the efficient operation of any automotive fleet. This includes not only the mechanics and their helpers, but also the lubrication men. With a fleet widely scattered over a considerable area, a traveling mechanical supervisor is used to assist the men in the individual garages.

A system of automotive bulletins has been developed whereby authoritative information pertaining to particular types of equipment, maintenance practices, fuels, lubricants, etc., is disseminated to assist the garage personnel. These bulletins are sent to the garage foreman, his superintendent and the company manager in the area. They tend to knit the organization closely together and have effected considerable savings in maintenance equipment and operating costs of the fleet, not only by giving the correct procedure, but also by explaining to the garage personnel the reasons behind the selection and use of certain types of equipment and supplies.

Garage and Service Buildings

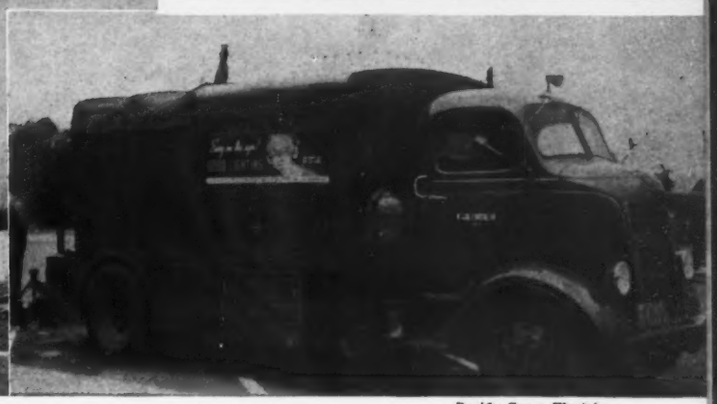
It is generally felt that preventive maintenance and repair work can best be done in company-owned garages wherever possible. These garages should be properly equipped and suitably arranged, illuminated, heated and ventilated. Several new garage and service buildings have been built during the past few years and the layout of the storage space, repair space, etc., was carefully worked out, thereby effecting appreciable reduction in the over-all space required, with consequent reduction in cost.

FOR BORING AND SETTING



Four Wheel Drive Auto Co.

Toledo Edison Company uses this platform body truck with boring machine and T-type derrick to bore holes and set poles. Cab over engine can transport seven men.



Pacific Gas & Electric

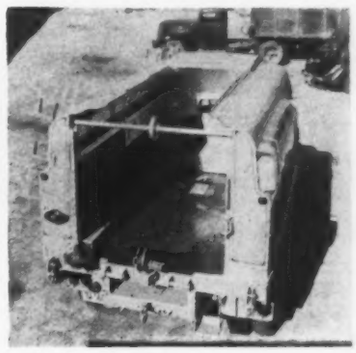
LOW-BED UNDERGROUND TRUCK

Pacific Gas & Electric cut off the frame of a standard cab-over-engine truck (a) back of the cab and installed a built-up low-bed attachment. Floor and body all steel. Over-all 168x94. Head clearance 80 in. Winch behind cab. Extended "niggerhead" in right side. Derrick on left rear will swing 180 deg.; operated by winch line passing through sheaves under floor. Pick-up 6,000 lb. Gross load rating 21,000 lb.

Trouble truck has watertight compartments for tools and materials. Felt-padded compartment for large fuses.

DIGS A MILE IN FIVE DAYS

Trench for underground conduit lines are dug at the rate of 800 to 1,000 feet per day on the system of the Long Island Lighting Company with this Cleveland trencher. Dirt from the buckets is dumped on an endless belt that ejects it to one side of the trench.



LIGHTER TRUCKS FOR LIGHTER DUTIES

By E. S. FITZ
General Manager, Electric Dept.
Virginia Electric & Power Co.

In our attempt to decrease maintenance and construction costs we have found it possible to use lighter trucks for line work and service purposes. Also, we have found it possible to work toward a type of body for each class of work which could be considered standard for our system. A 1½-ton chassis (a) appears to be satisfactory for most all general line work and a 1-ton service truck (b), used for cut-ins, repairing troubles and servicing customers' installations, meets our requirements. The tendency is toward all-metal construction for the bodies. On our newest line trucks we provide seats for six men, three on the driver's seat and three on a removable seat located over the hoisting drum.

PULLS THREE LINES AT ONCE

Public Service Company of Colorado uses this tractor at Idaho Springs to string three high-tension lines at once.

Caterpillar Tractor Company

The New Service Building Centralizes Departments Scattered by the Company's Expanding Operations

Surroundings Like These Make It Easy for Employees to Do Their Work Efficiently—A Few of Them Are Already Moved Into the Service Building

Modernization of Utility Buildings Cannot Stop

Investment Needs for Office and Service Buildings Analyzed With Respect to the Advantages and Disadvantages of Centralization and Customer Service

By EDWARD T. GUSHEE
Vice-President
and P. G. HEIDMAN
Detroit Edison Company

OFFICE and service buildings are as necessary to a public utility as power plants and substations. The office building of today is very different from the building used when records were kept by bookkeepers on high stools and few mechanical aids were available. Modern power companies, serving large metropolitan areas, require multi-story office buildings covering acres of floor space. These buildings house special telephone switchboards, some with automatic conveyors for rapid transmission of records; rows of filing cabinets; intricate equipment, such as comptometer, Hollerith, and addressograph machines, performing miracles in tabulating and accounting. The functions of the accounting, purchasing and engineering departments, to name only a few, are more efficiently performed when unified at a central location. The advantages of easy communication between departments when work is related are readily apparent.

On the other hand, for customer convenience, it is better to have commercial offices decentralized. Most customers have no contact with a company save through a commercial office. It is more pleasant and saves the customer's time if he can transact his business in a small neighborhood office near his home or work. For one thing, the neighborhood office provides more parking space, and with the steadily mounting number of automobiles to be parked in central business districts easy parking is an important factor. Then, too, when the electric lines extend to towns far from the metropolitan area, local offices become a necessity.

The problem resolves into two factors: (1) Provide facilities so that customers may be served with the utmost convenience to them. (2) Provide facilities for office employees that will enable them to perform their specified tasks in a centralized location in the interest of efficient management.

The growth of the modern power company has been rapid and continuous. During this period of rapid expansion it has been an ever-present problem to provide adequate office and service facilities. As an example of this growth, the Detroit Edison Company inherited from its predecessors a four-story brick building on Washington Boulevard that once housed both the company's offices and its generating plant. The company now has its headquarters in a ten-story office building with a total floor space of 223,674 sq.ft., occupying two-thirds of a city block. But the old building continues to function as a useful part of the company's property. The first floor is a commercial office and appliance display room, especially convenient because of its central location. The three upper floors, equipped with modern lighting, furniture and office appliances, accommodate the company's collection bureau and customers' accounts division. During this same period of growth old buildings on land purchased for future use, or buildings no longer suitable for their original purpose, such as abandoned substations, were made serviceable by careful modernization. New lighting was installed. Floor coverings, paint and wall board helped to transform unattractive structures into usable space. In one case an old piano warehouse was converted into office quarters to house the addressograph group. In another instance a group of old brick buildings was transformed into an acceptable downtown truck garage.

This use of existing space is entirely desirable. Remodeling often costs less than new construction, and property already acquired is turned from a tax-paying liability into productive space. Furthermore, congestion is certainly relieved. However, as growth continues, the decentralization of departments brings disadvantages, until finally the benefits which would be derived from centralization outweigh the cost of a new building. The Detroit Edison Company reached this point some time ago and the management decided to construct a new service building. This new building is located a block from the general offices and houses numerous departments formerly scattered in rented as well as in remodeled buildings throughout the city. It is a glass block building six stories high, equipped with modern elevators and completely air conditioned. The company has always tried to keep abreast of building improvements, believing that a public utility should furnish in its own quarters an example of efficient building construction.

Commercial Offices

The commercial offices represent the decentralized side of building maintenance. There are twenty branches at convenient locations in the city and one at every fair-sized city and village throughout the remainder of the service area, totaling 76 in all.

Commercial offices represent the company to the average customer. No effort is spared to make them efficient, pleasant, well lighted and well planned. Many of them are old buildings that have been transformed into modernized, good-looking places that do their part in improving the appearance of the community. One recent example of this kind of structure is an old bank building which was remodeled and now serves as a branch office at a busy intersection in Detroit. When the job was completed—new lighting fixtures, floor coverings, counters, display cases, etc., installed—the result was a very attractive branch office. In some of the smaller cities old residences at the edge of the growing business district have been purchased, remodeled by cutting a show window in front, removing some partitions, and thus made entirely serviceable. Renovation, installation of counters and good lighting make older structures usable until the growth of business justifies more extensive remodeling or a new building.

Lighting receives special attention in commercial offices. It is the company's practice to install two different classes of fixtures, representing two different types of lighting. Some offices are equipped with the last word in lighting. This serves to focus the customer's mind on the very newest developments. Other offices are furnished with fixtures of less advanced design which can be duplicated by most jobbers. The lighting from the latter, although not quite as good as that furnished by the more advanced fixture, is entirely up to standard. Further, these fixtures have a much wider market.

Demands of Better Service

As long as a company continues to expand its operations, its office and service buildings will need remodeling and modernizing. Steady growth means continuous progress—it is an unending procedure. Architecture, lighting, office appliances, even furniture and wastebaskets, wear out or become outdated, and should be replaced by materials of newer and more efficient design. Every year locations in need of remodeling should be selected and treated as the budget dictates. This work must go on at all times, even when its scope is necessarily restricted. The maintenance of commercial offices is not simply a matter of "keeping up appearances," but enables the company to serve the customer and the community more effectively. Good maintenance keeps up the value of the property and is sound business practice.

The office and service buildings of the Detroit Edison Company, as of every public utility, represent an investment of millions of dollars—a wise and cautious use of money to produce the best return to customer and company. This investment is by no means confined to large office and service buildings, but extends to idle and semi-obsolescent buildings which still possess some usefulness. These types of structures can be renovated with paint, linoleum and lighting when new buildings are not expedient, but the work cannot cease. The utility cannot stop—it cannot shut down and ride out the times of slack business. Sales and service activities must be sustained and often increased. Its methods must be improved to reduce expenses. Some departments are actually forced to expand during periods of restricted business activity because of the increased number of business transactions per customer during such a time.

Business depressions are invariably followed by business revival, and the utility must be ready to meet the demand. Office and service facilities, no less than turbines and transmission equipment, need to have adequate capacity. "Stand-by" machinery may not need to swing into action at a minute's notice, but it must be on hand.

The utilities of the United States could now, no doubt, profitably employ millions of dollars in the reconditioning of buildings and in the construction of new office and service buildings in order that they might more efficiently and more economically serve their customers.

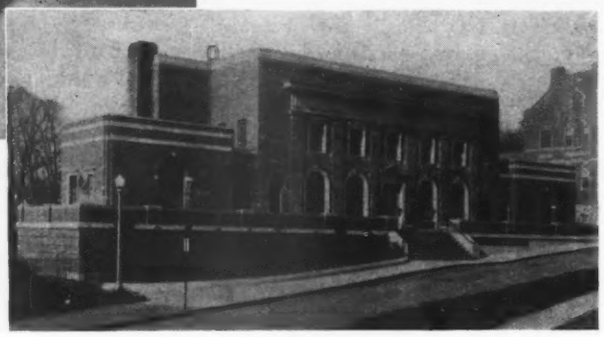
A New Suburban Office Simple but Attractive to Customers

Here Work is Dispatched to the Field Men—Conveyors, Switchboards and Ordered Routine Help to Make Customers' Service Work More Rapid

Photos courtesy Remington-Rand, Inc.

IMPROVED CUSTOMER CONTACTS

Customer history and service record filing system employed by Virginia Electric & Power Company, Richmond, Va., enables operators to give quick and complete information by telephone to customer contact men.

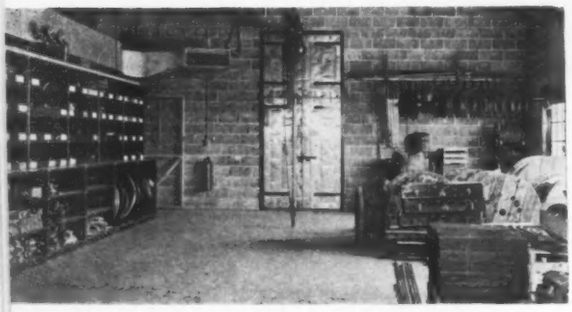


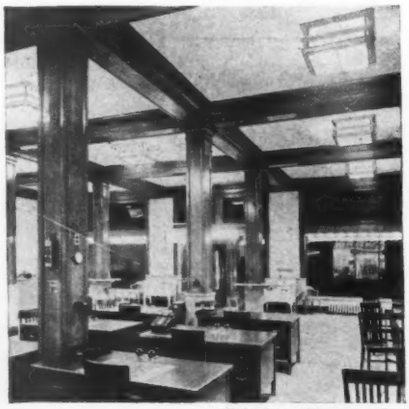
SUBSTATION COMBINED WITH OFFICE

Enlarged quarters of the Belmont (Mass.) Municipal Light Department combining a substation (shortly of 12,000 kva. capacity) with general offices and meter department. Switchboard equipment is undergoing modernization, the accompanying illustration showing a recently completed truck type transmission circuit breaker cubicle installation for 14.2-kv. supply from the Cambridge Electric Light Company.

GARAGE, STOCKROOM AND SHOP

Maintenance facilities on lines radiating from the New England Power System's Tewksbury, Mass., switching and substation have been greatly improved by the recent construction of a combination stockroom, machine shop and garage at this point. The garage houses four trucks and the storage facilities cover line material for circuits of 13.8 kv. to 220 kv., with day quarters for line crews, space for bushing racks, wire reels, hardware and many other supplies.





Holophane Company, Inc.

EIGHT HUNDRED WATTS PER UNIT

Appalachian Power Company uses fourteen units spaced 12x15 ft. in its Roanoke, Va., office. Each unit has four 200-watt lamps.

MERCURY-MAZDA IN UTILITY OFFICE

Southern California Edison Company's Santa Monica branch office is a fine example of modern lighting. Nine Mercury-Mazda luminaires on 16-ft. centers. Each unit contains one 400-watt mercury-vapor and five 200-watt Mazda lamps. After six months operation the light intensity averages 30-ft. candles.

Curtis Lighting, Inc.

System Development Program Moves Consistently Forward

By L. B. BONNETT and H. C. FORBES
Consolidated Edison Company of New York, Inc.

THE development and improvement of the electric system of the Consolidated Edison Company of New York is proceeding on an impressive scale.

At the Waterside generating stations work is under way on the installation of a 53,000-kw., 60-cycle topping turbine which will take steam at a throttle pressure of 1,200 lb. and a temperature of 900 deg. F. from two new 500,000-lb. boilers and will exhaust into the 200-lb. station header to supply steam for the operation of the existing 200-lb. units. This new topping turbine is expected to be placed in service late in the summer of 1938 and follows the installation of a similar 53,000-kw. topping unit which has been in operation since the fall of 1937. The combined capacity of the two new topping units is just about equal to the aggregate capacity of the old vertical turbine generators which they replace, so that the Waterside development thus far merely represents a modernization project and not an increase in system generating capacity.

The electrical galleries at Waterside No. 2, formerly in service at 11,000 volts, 25 cycles, are being completely rebuilt for operation at 13,200 volts, 60 cycles, and will serve as a supply to the alternating-current network system in midtown Manhattan. Their reconstruction is expected to continue throughout the years 1938 and 1939. In connection with the changes to the Waterside No. 2 electrical galleries, extensive rearrangements and some reinforcements to the 25-cycle and 60-cycle generating station tie systems were necessary, and this work is going forward steadily. It will probably be completed late this year.

Generators Being Rebuilt

It was originally intended to start work on a third 53,000-kw. topping turbine at Waterside some time during 1938, but in view of the uncertain business outlook it now seems likely that its installation may be deferred until the need for its capacity is more definitely assured.

At the Sherman Creek generating station two 20,000-kw., 25-cycle turbine generators are being rebuilt for 60-cycle operation. Their ratings will be increased to 30,000 kw. upon the completion of their reconstruction. They will operate at the same steam pressure (200 lb.) as formerly and are scheduled for service in the fall of 1938. In conjunction with the changes to the two generating units, a section of the electrical galleries at Sherman Creek, formerly in service at 6,600 volts, 25 cycles, is being replaced by a new 60-cycle bus section of the metal-clad type, for operation at 13,200 volts. This new 60-cycle bus section is being provided primarily to improve the reliability of the generating station as a distribution center and is scheduled for service in the fall of 1938. Upon the completion of the above changes Sherman Creek will generate and distribute exclusively at 60 cycles. The changes and improvements outlined are a preliminary to the further modernization of the station by the installation of topping turbines at such time as their added capacity may be needed to meet the growth of load in the surrounding territory.

At the Hell Gate generating station construction has been under way for several months on an additional section of the 60-cycle electrical galleries which is needed to provide for load growth and for proper diversification of the existing distribution feeders. This new section of the electrical galleries is to be completed during the summer of 1938. The existing sections of the Hell Gate electrical galleries are also undergoing substantial alterations which are directed toward the segregation of the buses and their further sectionalization with the intent of preventing any large scale trouble in the galleries and of reducing the number of distribution feeders which would be affected by a bus fault.

To provide additional reserve capacity to the system in Westchester County and to supplement the reserve available to the Niagara Hudson system over the interconnection between it and Consolidated Edison a 20,000-kw., 25-cycle generating unit at the Glenwood generating station (purchased from the New York Central Railroad in 1936), in the city of Yonkers, is being rebuilt for 60-cycle operation at a rating of 30,000 kw. Switching facilities and cables for connecting this unit to the transmission system in Westchester County are being installed and the entire project is planned to be completed in the fall of 1938. The plant will act primarily as an emergency reserve.

Plans are being made to establish a steam tie line from the Hudson Avenue generating station to the Gold Street generating station. These two Brooklyn stations are located one city block apart and the installation of the tie line will make it possible to operate the Gold Street turbines with steam from the Hudson Avenue boilers, thereby avoiding, under all ordinary conditions, the necessity of operating the older and less efficient boiler plant at Gold Street.

A.C. Network Being Extended

On the distribution systems, changes from overhead to underground service and extension of the alternating-current network system are proceeding for the most part at a retarded rate on account of reduced business activity. The demand for service to air-conditioning installations, however, is holding up rather well, undoubtedly reflecting a stimulus from the coming 1939-1940 World's Fair. The World's Fair itself, of course, constitutes a major distribution project, it being necessary to provide service for a load which has been estimated as high as 65,000 kw. In the area adjacent to the fair grounds extensive improvements to the distribution system are going forward in connection with the installation of conduits in advance of the paving of highways and the conversion of street-lighting service from overhead to underground. This work will, of course, have to be completed well in advance of the opening of the fair in the summer of 1939.

Sectionalization of the a.c. network system inaugurated during the past year, with a view to limiting the possible scope of network system disturbances and simplifying the problem of re-energizing the network in the event of a shutdown, has been vigorously pressed and the year 1938 will see its completion.

Fig. 1—System Program Evolving Consistently Since 1923

The basic pattern comprises a system of 132-kv. transmission lines and switching stations which ultimately will serve the entire Public Service territory. It provides a high-capacity transmission backbone linking the Public Service generating stations on tidewater with the inland load areas and provides facilities for high-voltage interconnection with other utility companies in New Jersey and Pennsylvania. The initial step in this program included the construction of the 132-kv. transmission lines between Marion and Essex generating stations and the new Kearny generating station which was placed in service in 1925. Two years later a 132-kv. transmission line was extended from Kearny to Athenia switching station, to serve the heavy industrial area centering about Paterson and Passaic. Future extensions which it is expected will be made as soon as the normal trend of load growth is resumed are also indicated.

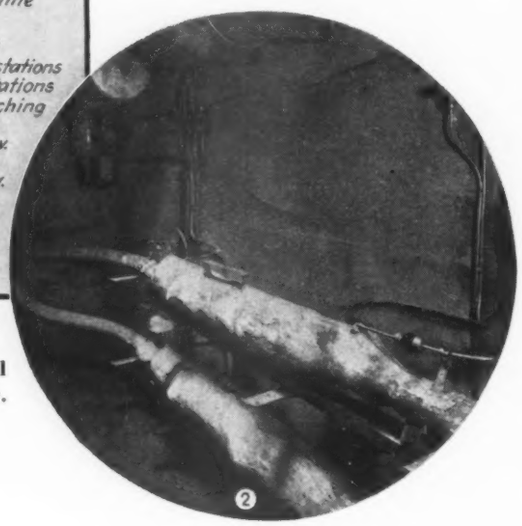


Fig. 2—Splices and Oil Reservoirs for 138-Kv. Oil-Filled Cable

System-Wide Developments Mark Eastern Utility Modernization

By MARION PENN
Manager Electric Department,
Public Service Electric &
Gas Company

DURING the depression years Public Service Electric & Gas Company of New Jersey has constantly had in mind the improvement of service to its customers, and has at no time during this period deferred expenditures necessary to provide or maintain a high standard of service reliability. New construction to take care of load growth has, of course, been much lower than normal due to lower capacity demands. We give herewith the more important recent developments in our system.

System Evolution, Co-ordination, Interconnection—The most recent addition to the system is the 132-kv. circuit between Essex generating station and Metuchen switching station, which was placed in service in December, 1937. The open-wire part of this circuit consists of 11.6 miles of tower line construction similar to that used on other sections of the system. In the section between Essex generating station and the site of a future switching station at Bayway, a distance of 9.3 miles, it was necessary, due to local conditions, to place this circuit underground. For this purpose a special duct line was constructed, and three single-conductor, oil-filled, 1,250,000-circ.mil, 138-kv. cables (Fig. 2) were installed. The cable installation is the first of its type placed in operation in the Public Service System.

This circuit, which constitutes the closing link in the 132-kv. ring, represents a major step in providing for greater reliability of service to the entire system by permitting the transmission of power in either of two directions from the generating stations and the 220-kv. interconnection point.

Power Plant Renovation and Expansion—Plans for additional generating and transmission capacity on the Public Service System are being studied continuously by engineering groups organized specifically for this purpose, and the location and approximate date of each new proposed addition are decided a number of years in advance of the actual installation. For example, a general plan has been established for the addition of a total of approximately 350,000 kw. of new generating capacity, as required by load growth, at the four major stations.

The program contemplates the installation of superposed units of approximately 50,000 kw. capacity each at certain locations and condensing units of approximately 100,000 kw. capacity each at other locations. Because of the variety of factors entering into the problem there is no fixed point of transition from superposed units to condensing units in this program. In other words, it is not expected that the company will proceed with a program of installing superposed units throughout until all of the older equipment has been thus modernized, and then proceed with the installation of condensing units. The exact sequence of the installation of superposed and condensing units under the plan will be determined primarily by the rate of load growth in the various areas and the local service and transmission requirements, as well as by the effect of the installations on system economy.

In 1936 the resumption of load growth indicated that additional generating capacity would be required to carry the system peak load in 1938. To meet this requirement a 50,000-kw., 1,250-lb., 950 deg. F. superposed tur-

bine-generator and two 605,000-lb. per hour high-pressure boilers were authorized for installation at Essex generating station. Construction work was started in March, 1937, and the installation is now nearing completion. Fig. 3 shows a view of the turbine-generator during construction.

In addition to feeding into the 132-kv. transmission system Essex generating station supplies load in the Newark and Elizabeth areas at 13 kv. and 26 kv. A total load of approximately 135,000 kva. is served by 39 13-kv. transmission circuits, all of which formerly were supplied from the Essex switch house.

In order to modernize the relay system and provide for the installation of larger oil circuit breakers to take care of increased short-circuit currents, as well as to provide switching facilities for the new generator, the complete reconstruction of the 13-kv. facilities at Essex generating station was authorized in 1937. As part of this project an outdoor 13-kv. switch yard (Fig. 4) has been constructed which provides facilities for fifteen feeders and three generators, thus materially reducing congestion in the indoor layout. The switch house is now being reconstructed according to the latest principles of indoor design to provide for the remaining 24 feeders and four generators. The resultant separation of generator and feeder facilities, together with the provision of complete differential protection on all buses, is expected to afford a maximum of service reliability for this important load area. Fig. 4 shows a portion of the new outdoor 13-kv. structure with the switch house in the background.

Transmission Systems and Switching Stations—As stated previously, Public Service is committed to a policy of planning major extensions several years in advance. This practice yields economies not only in such matters as the acquisition of land and the ability to devote more time to careful design, but also in permitting a step-by-step program of construction which more nearly matches increments of capacity with the requirements of load growth. For example, the future Bergen and Camden switching stations, as shown on Fig. 1, will be placed in operation initially with only one bank of 132/26-kv. transformers each, no high-tension breakers and a minimum of 26-kv. feeder positions. The initial transmission-transformer combination will operate for a number of years in parallel with the existing 26-kv. transmission lines feeding the area. As load growth requires, a second transformer bank, complete buses and switching equipment and additional 26-kv. feeders will be added, until ultimately the complete switching station supplying the entire area has been constructed.

The procedure which was followed in the case of Bergen switching station is an interesting example of the application of this general policy. In 1937 additional transmission capacity was required to the area ultimately to be fed by Bergen switching station. The right-of-way for the 132-kv. tower line and land for the switching station had already been purchased. As the first step in providing additional ca-

Fig. 3 — Essex Unit Added 500,000 Kw. to Capacity

This unit will increase the total capacity of Essex generating station from 193,000 kw. to 243,000 kw. This high-pressure turbine will furnish exhaust steam at 225 lb. pressure sufficient to generate approximately 70,000 kw. in existing machines, with an over-all heat rate of 12,000 B.t.u. per kilowatt-hour for the 120,000 kw. of capacity represented by this combination.

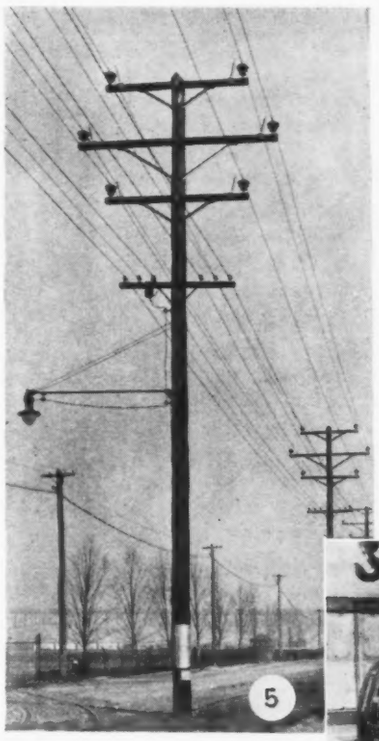
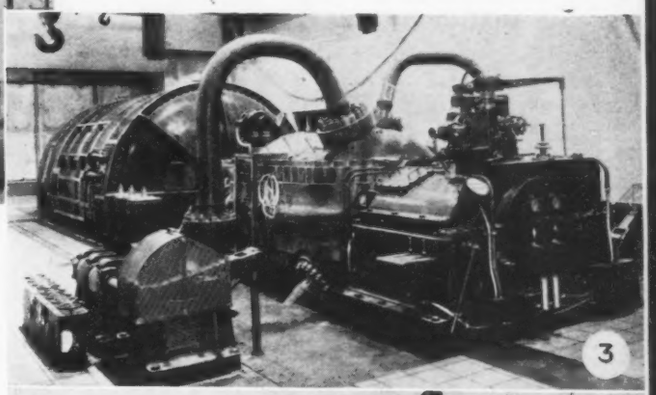


Fig. 5 — Experimental Installation of Lightning Protector Tubes on 26-Kv. Transmission Line

This installation was not entirely satisfactory and a new design was developed in which one phase wire was placed above the other two-phase wires and equipped with lightning protective tubes, in which position it acted as a lightning shield to the two lower wires. A new line under construction last year was built in accordance with this design, and the original line was reconstructed in this manner. This installation gave satisfactory results, except that the protective tubes used did not have sufficient mechanical strength. Stronger tubes were installed on a third line, and this year a portion of the original line is being equipped with the stronger tubes.



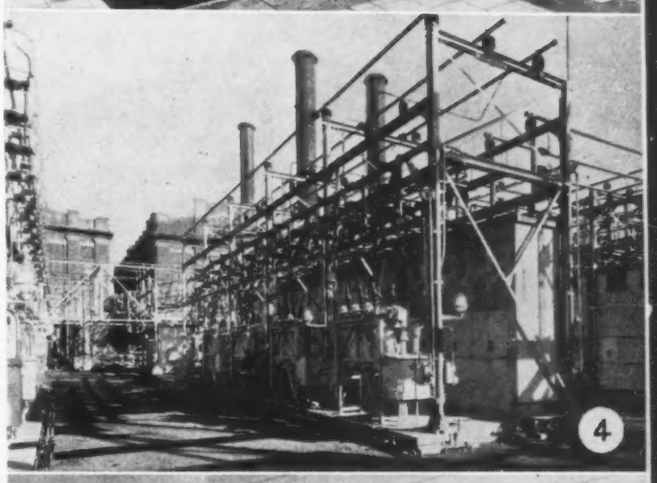


Fig. 4—Feeder Equipment at 13-Kv. Switchyard — Switch House in Background

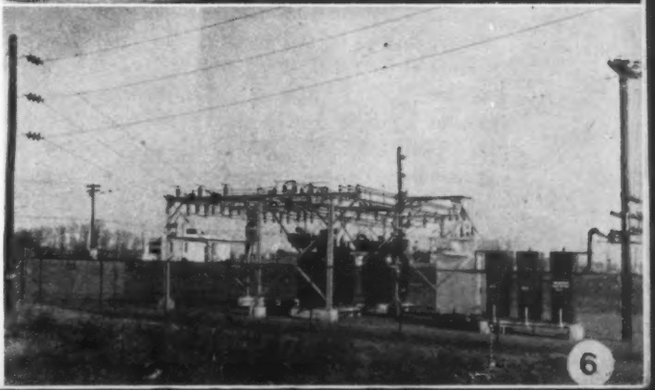
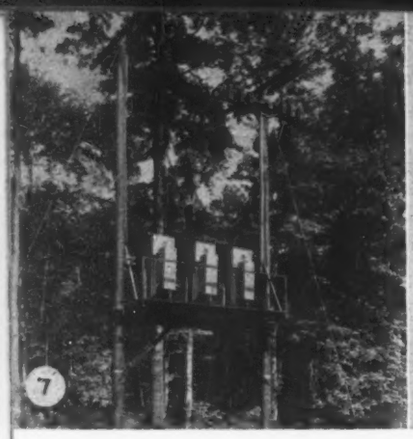
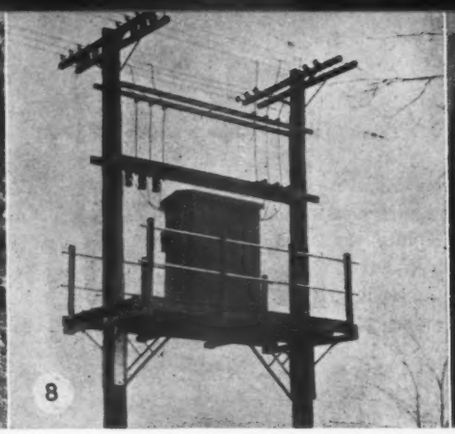
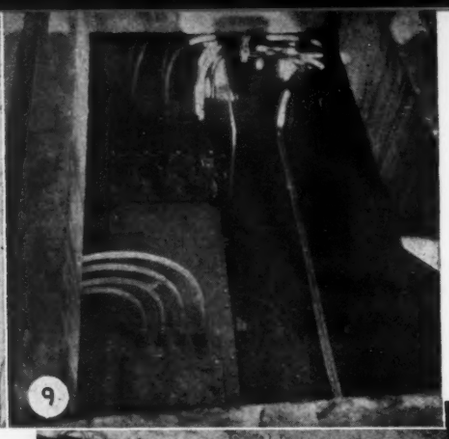
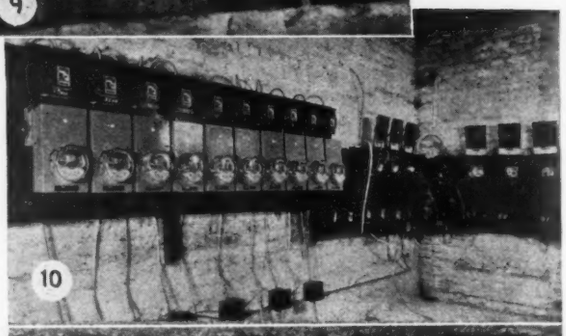


Fig. 6—Initial Unit (4,000 Kva.) Can Readily Be Expanded









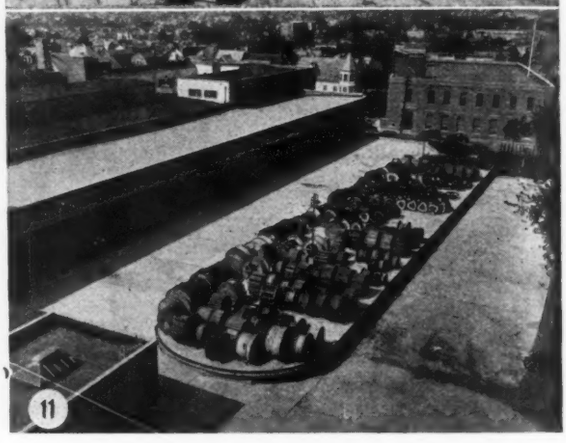


Fig. 7 — Five Miles From Substation a Three-Phase Installation of 200-Amp. Regulators

Fig. 8—Series Capacitor Eliminates Voltage Dips and Enhances Steady Load Capacity by 40 per Cent

Fig. 9—Typical 300-Kva., 4,150/208/120-Volt, Three-Phase Network Vault — 1,200-Amp. Network Protector in Standard Manhole With Removable Slab Roof

Fig. 10—New Meter Service Installations Supersede Obsolete

Fig. 11—Storage Yard Adapted for Use as Distribution Headquarters

pacity to the area, a double-circuit 132-kv. tower line, approximately 8 miles in length, was constructed to the future switching station site, and these two circuits were tapped in to the existing 26-kv. transmission system in the Bergen area. By operating these circuits initially at 26 kv. the transmission capacity to the area was increased by approximately 25,000 kva. and an expenditure of approximately $1,000,000 for high-voltage transformers and switching equipment was postponed for a period of approximately two years.

Protective Equipment—In order to decrease the duration of transmission faults and the probability of interruption of unfaulted circuits, a program for the replacement of slow-speed relays with high-speed relays is being carried out. In connection with the completion of the closing link in the 132-kv. transmission ring a pilot-wire relay system was installed to insure proper selection under all fault conditions. It is expected that further applications of this type of relay will be required in the future.

Experiments have been carried on for several years in an endeavor to improve the lightning performance of 26-kv. wood-pole lines. In this connection one line (Fig. 5) was equipped experimentally with lightning protective tubes on all three phases. New lines will be constructed to accommodate the evolved type of lightning protection, and if the new tubes prove satisfactory a program for rebuilding open-wire lines will be undertaken.

Distribution Substations—As an example of the step-by-step construction policy previously explained, a new outdoor substation was constructed in 1937 to provide additional capacity in a growing industrial area which previously had been fed by long distribution circuits from three existing substations. The initial installation consists of a single transformer bank having a capacity of 2,000 kva. and a single 4-kv. distribution circuit. By the omission of high-tension switches and the utilization of transformers and induction regulators available in stock, the capital outlay was reduced to a minimum.

This equipment will supply the load in the immediate vicinity under normal operating conditions. Overhead ties to the original feeders from adjacent substations are being retained for emergency cutover. When the load in the area exceeds the capacity of 2,000 kva. the initial unit (Fig. 6) will be expanded to our standard substation design by the installation of additional transformers and 4-kv. feeder equipment, together with automatic high-tension switching equipment.

Overhead Distribution—During the past ten years the overhead distribution plant has been the subject of intensive study by company engineers. Improved voltage regulation, greater reliability of service and reduction in annual cost have been the guiding principles in all of these studies. In the effort to provide better voltage regulation, particularly on the longer circuits extending into rural communities, extensive use has been made of induction regulators (Fig. 7) mounted on poles. The company now has in service 41 regulators of this type, ranging in capacity from 50 to 200 amp. In addition to induction regulators for service on the larger circuit branches, a number of single-phase step regulators have been installed to improve voltage on small rural extensions.

In a number of cases the frequent starting of motors at remote points on distribution circuits has caused annoying voltage dips throughout several miles of line. Because of their relatively slow response, induction and step regulators cannot remedy such conditions, and the installation of heavier conductors will provide only partial relief. One particularly severe condition of this sort was experienced on a long circuit fed from Princeton substation. It was estimated that the construction of a separate circuit would cost at least $30,000, and because of the distance this would not

[*Continued on page 174*]

Opening of TVA Hearings Disappointing

By CARTER FIELD

This noted journalist gives his personal comments and interpretations on current happenings affecting the electrical industry. His background and his location at Washington make his thoughts informative and interesting even though all may not agree with him

TWO amazing developments, little heeded by the daily press, stand out in connection with the disappointing and dreary opening of the long-awaited Congressional investigation of TVA.

Most surprising was the decision of David E. Lilienthal, and obviously of the President, to throw Senator George L. Berry of Tennessee to the wolves.

The second was the concept of the "yardstick" held by Lilienthal, as attacked by Arthur Mo gan, and as virtually admitted by Lilienthal.

The decision to throw Berry overboard seems excellent strategy. It was the one attack made by Arthur Morgan which seemed likely to excite the country. It was surprising because, even after the exposure of Berry's attempt to get a few millions out of the federal treasury by selling submerged marble to the TVA, after the ethics of this operation were sharply criticized by Arthur Morgan, and even after a condemnation commission had held the marble worthless, and exposed the fact that Berry was virtually operating on a contract which would give him 62½ per cent of the "take," the President had written a letter persuading Representative McReynolds of Tennessee not to run against Berry in this summer's primary. The President was very anxious to retain a sure New Deal vote in the upper house.

Sensationalism Gone

So it had been assumed that Berry would be defended, by Lilienthal and by H. A. Morgan. Decision to throw him overboard, and impugn his motives, relegates what might have been a sensational phase of the whole investigation to a mere question of which course in handling Berry's claim was the wiser, that insisted upon by Arthur Morgan, or that actually followed by the two other commissioners and their counsel.

It became obvious in the hearing that Arthur Morgan had so irritated all of the TVA counsel in this case that it would be little short of a miracle if any of them should later testify before the committee in a way which would reflect credit to Arthur Morgan, or discredit on Lilienthal.

Lilienthal's concept of the yardstick, strangely enough, seems to be almost the least disputed factor in the whole disagreement. Boiled down, Arthur Morgan charged that Lilienthal wanted to charge against power only the actual cost of constructing the turbines and other machinery and the power houses. He would allocate all the cost of the dams, of the land to be flooded, etc., against flood control and navigation.

Further, Arthur Morgan charged that Lilienthal did not make any allowance for the tremendous promotion expenses incurred not only by TVA personnel, but by employees of other branches of the government. The exact point attempted here by Arthur Morgan was that Lilienthal was representing to the President, to Congress and to the country that the *sole* reason for the huge boom in use of electricity in the sections served was the cutting of the price.

Lilienthal's answer to this was that the cost of such promotion work was duly entered on the books for all to see. He did not claim that the cost of this promotion work, and particularly that of employees of other government units not connected directly with TVA, and therefore of course not shown on its books, had been appraised in figuring the cost to the government of the sales of current thus obtained.

Aside from these two highlights, the proceedings to date have proved a tremendous disappointment. General consensus is that Arthur Morgan was hurt worse than his enemies, Lilienthal and Harcourt A. Morgan. Even A. E. Morgan's best friends admit that he was most ineffective, and that Lilienthal and H. A. scored heavily in their attempts to portray him as a meddlesome, cantankerous zealot. This has nothing to do with the merits of the case. Actually, little was brought out in the evidence which would change any one's mind.

Morgan's attack in quoting reports made by Lilienthal to the President and to Congress, and in public statements and speeches, showing gross deceptions and inaccuracies, are calculated to impress engineers, utility men and any disinterested students who will plow through the testimony. But they apparently impress salesmen and business men as just ordinary sharp business practice. The kind of thing often resorted to in real estate promotion. In fact, the sort of thing that makes the phrase *caveat emptor* necessary.

Public Reaction

Morgan's friends here are deeply regretful that he did not use some phrases and epithets which would make good fighting headlines in the newspapers. They admit few disinterested people would read through the statements, and they wish there could at least have been newspaper headlines which would have fanned public excitement about the case.

Hints are plentiful that Arthur Morgan is reserving his fire until Lilienthal and H. A. Morgan have been dragged out into a more exposed position, and until A. E. can dig up chapter and verse to prove his case from the official records, now opened to him by committee order. These may be true, but the general impression is that Morgan has fired most of his ammunition, that Lilienthal and H. A. Morgan got off the hook by joining in A. E.'s attack on Senator Berry, and that, for the future, Lilienthal is obviously so much more adroit and clever in this business of presenting a case, either to an investigating committee or to the public, that there is not too much expectancy that Arthur Morgan will regain the position in the general public's mind about this case that he won right after the President threw him out of office.

Meanwhile the committee will send investigators to the scene, who, it is hoped, will be ready to furnish the committee material on which to proceed when the hearings are resumed.

Editorials

S. B. WILLIAMS, Editor

Large Attendance Expected at Convention

NEXT WEEK at Atlantic City the Edison Electric Institute holds its sixth annual convention. In spite of the depressed business conditions there is every indication of this being a largely attended meeting. The program reflects the trade association character of the organization, with avoidance of discussions that now or later might be used against the industry. In fact, the weight of the program this year, somewhat contrary to precedent, is being carried by junior executives.

During the year that has intervened since the last convention a lot of water has passed over the dam. A situation of increasing load has given way to one that is falling. A year ago the Administration was suggesting peace overtures; today it is promoting municipal ownership. Within the year several court decisions have been handed down which, if not helpful to the utilities, at least have clarified the situation somewhat. The TVA investigation is on, while the authority appears to be making some headway in its negotiations for purchase of privately owned systems. The relationship between the industry and the SEC in the administration of the Holding Company Act appears to be improving.

All in all, therefore, there is a lot to be discussed that does not appear on the agenda for the meetings. Considering the off-the-record and out-of-the-meetings discussion, this convention can easily go down as one of the most important held by the E.E.I. in the short five-and-a-half years of its existence. The advance registrations would seem to bear this out.

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National Defense Power Survey Suggests Questions

THERE is talk of a national survey to disclose where power systems in important areas need to be reinforced as a defense measure to render them less vulnerable in the event of war. Abroad they are in the throes of war threats and have started putting continental stations and substations underground. In England the Battersea station windows have been sealed, and there are proposals to build bomb-proof domes over principal stations. We here are not likely to think in such terms, but rather in terms of back-up interconnections.

But just why should this be the subject for a new survey? Murray and Flood made an Eastern seaboard study, Hoover as Secretary of Commerce directed another, and since then the Federal Power Commission has collected enough data in its power survey to provide the information needed. Can it be that the proposed survey has any connections with revival of the Administration's dream of a 500-kv. backbone line and that the defense-measure interconnections would be detached vertebrae of an embryo spinal column on which to hang a multiplicity of pet projects?

No one will oppose the principle of reinforcing power systems where they may be vulnerable from the standpoint of public defense. Obviously, continuity of power supply is vital in wartime; in fact, to such a degree is this essential that it may require reinforcement that could not be justified by ordinary business economics.

But aside from the possible political angle, there are questions of a practical nature that would have to be settled before the investigations are too far advanced. Who will pay for such interconnections as are proposed? Who will maintain and have jurisdiction over them? Shall they be used for any purpose other than power emergency in time of war or insurrection? These are very real questions, since any lines that would be built for defense purposes would hardly be found useful for daily operation because most all such lines as could be justified by the economics of diversity or allocation of reserves have already been built.

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Power Policy the Root of TVA Investigation

THE curtain has been raised on the Congressional investigation of TVA. Fortunately or unfortunately, as one looks at it, the publicity attending the opening hearings centered on the conflict between the directors. The charges and counter-charges lacked some of the sensationalism that inflames the public, and for that reason the personality phase of the investigation may arouse little public enthusiasm.

However, the important thing is not the disagreement that existed between the three directors. That, after all, is but the incident which brought to light the necessity for the investigation. Far more important is the need for getting to the bottom of the authority's power policy.

Dr. A. E. Morgan has done the country and the committee a service in outlining the course the investigation must take. He has drawn attention to the con-

tracts with large customers, to the accounting practices, to the "yardstick," to the relation with private utilities and municipalities within the range of TVA power, to income from the sale of power.

While the investigation will have to be confined to the TVA, the effects should reach much further. As a matter of fact, the whole power program of the Administration is concerned, for any policy set up by Congress for the Tennessee Valley as the result of facts disclosed by this investigation must necessarily be fundamental for other government power projects.

In the meantime, the Supreme Court has agreed to review the decision of the three-judge Federal District Court upholding the TVA activities. What effect, if any, the disclosures of the investigation will have upon the outcome of the litigation is, of course, a matter only for speculation. Certainly, however, within another six months the future permissible operations of TVA should be pretty well decided between Congress and the Supreme Court.

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No Time to Let Up on Market Development

THREE years ago the National Electrical Manufacturers Association began its business development program and gradually has extended its operations until now it is engaging in something over twenty separate activities. Each one of these operations is designed not only to provide more business for electrical manufacturers but also for one or more branches of the electrical industry.

These activities, while not conceived or executed in the large and grand manner that have characterized some promotional programs in other industries in the past, have nevertheless cost a considerable sum of money. And in these days of reduced sales volume and mounting expense it is not inconceivable that the advisability of continuing this expenditure has been questioned by more than one subscriber.

One of the features of market development work is that it builds up momentum with continuity, but loses it even more rapidly when the effort falls off. The results that have been achieved so far are nothing short of remarkable considering the amount of money spent. While this has been due, to a large extent, to careful planning and efficient management of funds, it has also been possible only because of the excellent co-operation which has been received from the rest of the industry.

The electrical industry has shown its desire to co-operate in market development, to get behind a well-conceived plan of endeavor and go to town. In fact, if this activity had done nothing more than it has to bring this industry closer together, it would have been worth every cent it cost. Nothing before has ever brought the industry so closely together, and now that we are going places everything should be done to keep up the programs.

By working together, this industry can come pretty near to pulling itself out of the present low state of business by its own bootstraps. Certainly, it can do more by working together on a planned program than it can otherwise.

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A Stimulus to Better Public and Trade Relations

IRRESPECTIVE of how the Senate votes this week on the proposed amendment to Section 201 of the pump-priming bill, it must be fairly obvious by this time that the Administration is determined to increase the scope of public ownership of electric utilities. With nothing down, nearly half of the project an outright grant and the balance payable over a long period of years out of the profits from operation, it is going to be difficult for ambitious politicians to restrain themselves. Of course it is unfair. Everyone knows it is unfair. The Administration, backed up by court decisions, makes no bones about it. Rates, say the anti-utility advisers of the President, are too high, and one quick way to reduce them is to substitute competition for regulation.

The ordinary threat of municipal ownership can be combated in several ways, but this is of a different nature. A city does not have to go before the voters with a bond issue. Many city fathers, no matter how they have stood previously on the municipal ownership issue, will feel that this is too good a proposition to pass up.

However, the people will not all be fooled. They can be shown that subsidized municipal ownership can be extremely expensive. They can be shown that private ownership, in addition to low rates, does for the community something which the publicly owned plant, lacking in the profit motive, seldom feels obligated to do, namely, build local business.

And here is the urgent need for good customer, community and trade relations. The company which has provided good service at reasonable rates, has trained its employees to give customers no cause for complaint, has taken a definite part in community improvement and has helped the local dealers and contractors to build up business—that company should have little trouble combating subsidized municipal ownership.

With the pump-priming program as presently set up, no company can sit back and say that it is safe from attack. The pestilence can strike in almost any spot at any time. The safe plan is to be prepared. Any company, therefore, which has not already set up a program of stimulating customer and trade relations should find in this pump-priming proposal the definite stimulus to start work in this direction immediately.

News OF THE WEEK

Congressional Committee Sifts TVA Charges as Inquiry Opens

Former Chairman Morgan expresses belief in agency, but wants to bring about better administration — Lilienthal defends power program and utility negotiations — Harcourt Morgan traces split

With an agreement to hear all three members of the Tennessee Valley Authority without interruption, the special congressional committee appointed to go into that situation got under way May 25. Former Chairman Arthur E. Morgan consumed the entire first day, while David E. Lilienthal and Harcourt A. Morgan consumed the next with their counter-attacks on the former chairman.

At the conclusion of these uninterrupted broadsides the committee adjourned subject to future developments, expectancy being that investigators would go to the scene, and that Arthur Morgan, with authority granted by the committee, would have access to all TVA books and records, with a view to getting details and supporting evidence to amplify his case later.

Meet after adjournment

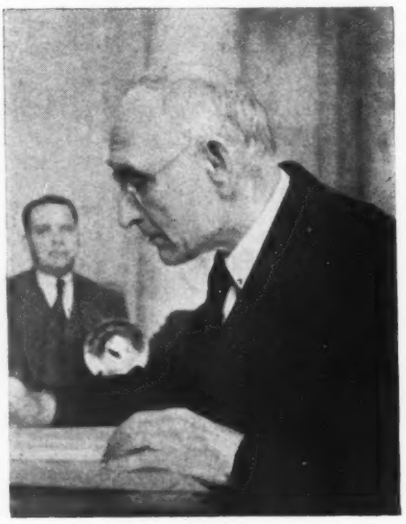
In his opening statement Dr. Morgan insisted that he was earnestly and sincerely for the TVA program.

"It is an instrumentality actually and potentially of very great value to the people," he said, "and a contributor in a large way to the public welfare. I believe in the feasibility and wisdom of the act of Congress creating the authority. I shall not be a party to any effort to break down the authority or limit its effectiveness. My whole purpose is to strengthen the authority by helping to bring about a better administration of its affairs.

"In the long run, the greatest danger to the TVA lies in improper administration. If the TVA is honestly and soundly managed, and if present abuses are corrected, no amount of opposition from without will defeat its purposes. On the contrary, continuation of present policies and practices will defeat its purposes."

Promising more details when he could examine the records, Arthur Morgan cited some instances to the committee. For instance, he said Mr. Lilienthal, reporting to the President on revenues, said: "Starting from scratch and with the entire market monopolized as of September, 1933, there was produced and used at Wilson Dam power of the value of $1,197,000, an increase over the preceeding fiscal year of 100 per cent."

A. E. Morgan pointed out that sales of Wilson Dam power had been $872,000 in 1926, $1,169,000 in 1927 and so on to 1933, when they amounted to $560,000, averaging over these years $673,000 a year. In the three succeeding years, he said, sales were $825,550; $368,510 and $827,000 respectively, an average of $673,000—the same amount.



Arthur E. Morgan

David E. Lilienthal

On the word "monopolized" as used by Mr. Lilienthal in this report to the President, Arthur Morgan pointed out that more than 40 per cent (seven out of seventeen) of the communities served by TVA as of June 30, 1936, operated and owned their own generating and distributing systems in 1933.

Arthur Morgan attacked Mr. Lilienthal's report to the President, saying TVA contracts with municipalities were for 100 per cent firm power, while contracts with industrial customers dispose of part firm and part interruptible power "which municipalities cannot use."

Defending his retaining of G. W. Hamilton, a former Insull officer, Arthur Morgan read the President's letter of September 17, 1936, inviting him to the White House to discuss a power pool in the Southeast.

Mr. Lilienthal had said at the White House in attacking Arthur Morgan: "It was not permissible for Arthur Morgan to collaborate with a former chief engineer of the Insull utility system in the preparation of a detailed recommendation on a power pooling policy." Arthur Morgan told the committee that he was dissatisfied with a report prepared by Dr. Martin G. Glaeser, who had been selected by Mr.

Harcourt A. Morgan

Lilienthal, and thereupon felt that in his duty to aid the President in "exploring the possibilities" he had consulted G. W. Hamilton, "already employed by the board as a consulting engineer."

Arthur Morgan, after defending the use of Mr. Hamilton, pointed out that Mr. Lilienthal had appointed W. I. Nichols as head of the "Division of Electrical Development," although Mr. Nichols' sole previous experience in the electric power field was with the Insull organization.

Arthur Morgan charged that in spite of Lilienthal's insistence that TVA made no attempts to influence local elections on the municipal power issue, he timed an announcement of the starting of preliminary investigations at the Chickamauga Dam site to influence an election in Chattanooga.

Mr. Lilienthal, Arthur Morgan insisted, had reserved to himself contact for TVA with private utility executives, but had misrepresented to the board and to the public the actual attitude of Wendell L. Willkie, president of Commonwealth & Southern. Even when reproached by both Mr. Willkie and Arthur Morgan that a public statement about to be issued was not an accurate statement of Mr. Willkie's views, Mr. Lilienthal rushed it out to the press.

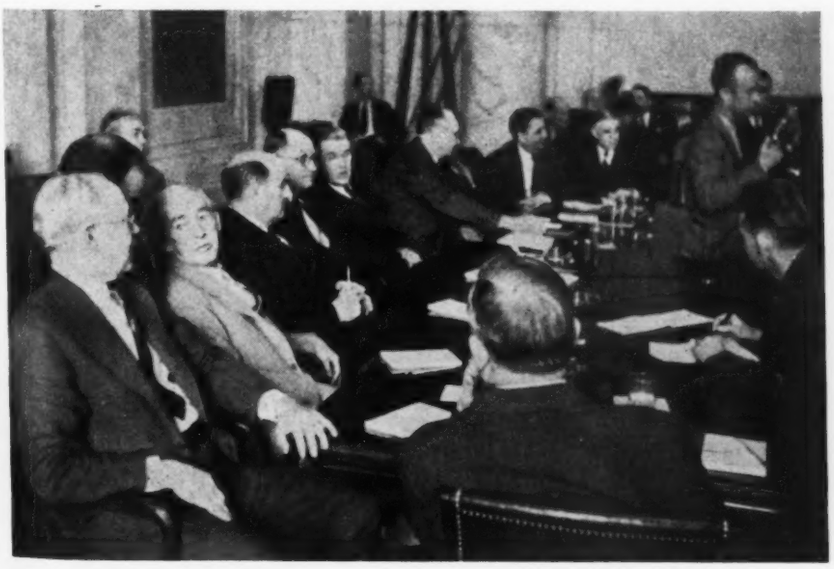
On the "yardstick," Arthur Morgan charged that Mr. Lilienthal deceived the public, Congress and the President by not including all the costs of selling TVA power. Particularly, Mr. Lilienthal had not included any part of the actual cost of the dams or land acquired, allocating all of this to flood prevention and navigation, and only charging the actual cost of the power houses and machinery to power. Also, that a tremendous sales promotion campaign, participated in not only by TVA employees but by employees of other agencies of the government, was not properly debited to power cost. Finally, that Mr. Lilienthal had represented the big jump in power sales exclusively to the reduced price, although this expensive educational, selling campaign was largely responsible.

Arthur Morgan charged that H. A. Morgan voted constantly with Lilienthal and against him because Mr. Lilienthal gave H. A. Morgan a free hand on agriculture and fertilizer.

Mr. Lilienthal in his statement to the committee insisted that the fight of Arthur Morgan and of the utilities was the same old fight which had been defeated three times in Congress—the fight against the government going into the power business. He denied misrepresenting Mr. Willkie's views.

To Arthur Morgan's charge that TVA did not compute promotion expense in figuring rates, Mr. Lilienthal replied that the very computation of wholesale rates contained an item of $100,000 to be devoted to this purpose.

Harcourt A. Morgan in his testimony traced the history of the cleavage which so speedily resulted in dividing the TVA into two factions, H. A. Morgan and Mr. Lilienthal on one side and Arthur Morgan on the other. Arthur Morgan, he said, started off to make it a one-man show, with the two other directors as puppets. Also, Arthur Morgan outlined schemes and plans which seemed to him visionary and unrelated. Once the move was made by Mr. Lilienthal and H. A. Morgan to divide the job with one commissioner in charge of each section of the functions, Arthur Morgan began conspiring to get some one else appointed in Mr. Lilienthal's place, even going to the length of holding up the prospect of getting Mr. Lilienthal's job for two subordinates.



OPEN INQUIRY—Joint legislative committee hearing testimony of the three TVA principals and their charges and counter-charges concerning the operations of the giant federal power project in the Tennessee Valley

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Utility Committee Confers with SEC

The Securities and Exchange Commission at its first conference this week with the committee of five utility executives headed by James F. Fogarty, president of the North American Company, representing fourteen utility systems, suggested that a larger consulting group representing the utilities be formed to take up additional subjects arising under administration of the Public Utility Act.

At the meeting the utility committee reaffirmed its belief in the "principle of diversity," but indicated, according to a statement by SEC, "its belief that some constructive progress could be made under the statute." The SEC stood by its position that it would be possible for the commission and the utility industry to work out a solution of joint problems within the framework of the act without repeal or substantial modification of Section 11. Both sides at the conference, however, expressed gratification at the progress made toward a better relationship between the SEC and the industry.

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I.E.S. to Meet at Briarcliff

An all-day meeting will be held by the New York section of the Illuminating Engineering Society on June 10 at Briarcliff Lodge, Briarcliff Manor, N. Y. Professor H. B. Dates, president of the society, will be honored in the evening at "President's Night."

PWA Gives Approval for Utility Purchases

Tentative approval for the creation of a "Little TVA" in Nebraska through the purchase of ten private utilities by the state's three public power districts was given last week by H. A. Gray, Assistant PWA Administrator.

In a letter to the power districts, Mr. Gray stated that the PWA would consent to a reasonable modification of their financial arrangements with PWA to clear the way for the purchase of the utilities. This would result in a modification of existing loan contracts to permit the necessary financing of the purchase of the utilities.

"PWA is heartily in accord with your aim to secure an immediate market for the electric energy which will be produced by the public hydro-electric facilities in Nebraska," Mr. Gray wrote, "and in so doing bring about an even wider enjoyment of the benefits of cheap electric energy."

•

Associated Gas Posts Vacated by Officers

Last week when the Federal Power Commission was all set to go into details of interlocking positions of Associated Gas & Electric none of the 23 officers and directors of the system appeared at the hearing. The commission counsel read into the record notification of resignation and withdrawal of the applications of the entire group.

The commission stated that this is the second time when key executives in the Associated Gas & Electric System have filed notices of resignation and withdrawal of applications following orders of the commission for public hearing of their applications.

Under the Federal Power Act it is unlawful for public utility executives to hold interlocking directorships or officerships in two or more companies within the preview of the act without commission approval.

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Farm Interests Co-operate on Rural Investigation

Assisted by B. H. Standley of the Houston Lighting & Power Company's agricultural department, the State Agricultural and Mechanical College of Texas will select a number of farms in Harris and adjoining counties for the purpose of determining how farmers are using electricity to increase their rural profits and improve their standards of living. Mr. Standley and representatives of the college will co-operate with the agricultural agents of the several counties, vocational agricultural instructors and others in disseminating the information obtained.

Due to this big increase in rural electrification there has developed a need for definite and accurate information on the operation of electrical equipment applicable to the farm.

•

Sacramento Starts Move for Utility Unit

First definite condemnation move against Pacific Gas & Electric was made in Sacramento last week, after attorneys for the Municipal Utility District filed, in San Francisco, a petition asking the State Railroad Commission to institute condemnation proceedings.

After studying the petition the commission's next step is to call, on 90 days' notice, a hearing, at which P.G. & E. must show cause why commission engineers should not make inventory and determine valuation of the distribution system. Inventory may take three years, and the company can contest the valuation figure in state courts.

Residents of the utility district have voted $12,000,000 for acquisition of the electrical distribution system, and district directors have sold $300,000 worth of bonds to finance condemnation proceedings.

•

Basin States Fight Boulder Contracts

Attempts by Los Angeles and other southern California light and power interests to negotiate new contracts with the Department of the Interior under the Boulder Dam project act met vigorous opposition from the four upper basin states on the Colorado River. Governors and water conservation officials from Colorado, Utah, Wyoming and New Mexico unanimously protested the proposed new contracts at the conclusion of a two-day meeting in Denver. Meanwhile, the fight of the upper basin states for their Colorado River rights assumed an international aspect when a letter was drafted opposing efforts of Mexico to appropriate additional water from the Colorado.

Gov. Teller Ammons of Colorado said the letter would be forwarded to Harold L. Ickes, Secretary of the Interior, as soon as governors of the four states had signed, asking the secretary to aid in a program to assert priority rights for the upper basin states against Mexico.

Virginia Utility Elects New Board Members

Acting under a stipulation approved by the State Corporation Commission, the Virginia Public Service Company recently elected two citizens of Virginia as directors, giving the public interests of the state a majority of five of the nine directors. Jay W. Johns of Charlottesville, former president of the State Chamber of Commerce, and William H. Schwarzschile, prominent merchant and banker of Richmond, were elected the new members. Mr. Johns becomes chairman.

The other Virginia representatives on the board include Lloyd U. Noland, Newport News banker and business man; Fred L. Watson, Charlottesville financier and real estate man and former mayor of Charlottesville, and Gilpin Wilson, Jr., former councilman of Staunton.

Other members of the utility board include M. J. O'Connell of Warrentown, president; F. A. Mitchell, vice-president and general manager; J. M. Costello, secretary and treasurer, both of Alexandria, and T. W. Moffat of New York City. The two vacancies on the board will be filled later by public representatives.

Mr. O'Connell stated that "we expect to accelerate our progress in improving our service in all areas served by the company and to satisfy all our consumers so far as it is within our ability."

The stipulation was the outgrowth of charges filed with the commission by Alex Speer, former president, and the institution of inquiry proceedings.

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Additions Near Completion

Several improvements which are near completion have been announced by W. Marshall Dale, vice-president and general manager of the Indiana Service Corporation at Fort Wayne. These include extensive additions to the Webster Street substation and other improvements on the company's underground network for electric power distribution in the downtown area of Ft. Wayne. The work will cost approximately $50,000 when completed.

The new projects will result in increased ability to serve customers through the installation of large transformers and suppemental equipment. Improved voltage regulation will result, due to a better matching of installed capacity against the actual power demands at various points throughout the network system, Mr. Dale stated.

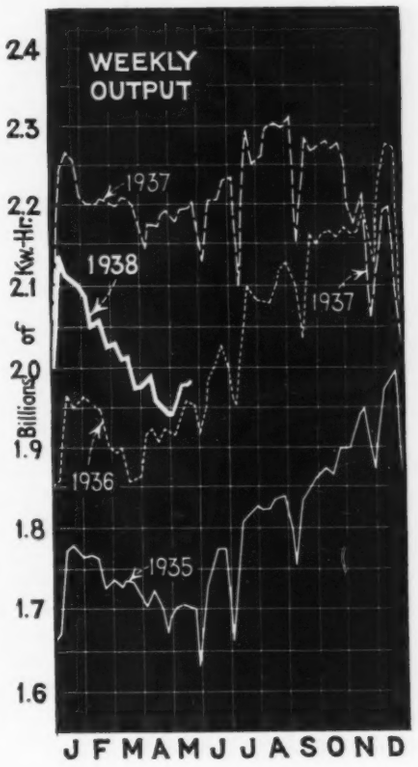
Output Rises Moderately

Energy production, on upward trend, is 2% above recent sag — Lacks 10.6% of matching 1937

Production of energy by the electric light and power industry continued on a mildly upward trend during the week ended May 28, the output as reported by the Edison Electric Institute amounting to 1,973,278,000 kw.-hr. It fell short of the output a year ago by 10.6 per cent, which is also the average disparity for the preceding six weeks.

Thus the gap between the curves for the two years, after widening until the latter part of April, has ceased to increase. Whether this is the prelude to the next movement, when the figures will begin to creep up on those of last year, time alone will reveal. Compared with 1936 there continues to be a small gain, now about 1 per cent.

Comparisons by geographic divisions reveal little change in the general pattern. The Middle Atlantic is down only 2.8 per cent from 1937 and makes its best showing since early April, but the Central Industrial, off 17.4 per cent, shows no advance. The Mountain region still lags most.



Weekly Output, Millions Kw. Hr.

1938	1937	1936
May 28..1,973	May 29..2,207	May 23..1,955
May 21..1,968	May 22..2,199	May 16..1,962
May 14..1,968	May 15..2,195	May 9..1,948
May 7..1,939	May 8..2,176	May 2..1,929
Apr. 30..1,939	May 1..2,194	Apr. 25..1,933
Apr. 23..1,951	Apr. 24..2,188	Apr. 18..1,915

Per Cent Change from Previous Year

Region	Week Ending May 28	May 21	May 14
New England	—11.6	—12.7	—11.4
Middle Atlantic	— 2.8	— 3.5	— 3.0
Central Industrial	—17.4	—17.1	—16.6
West Central	— 6.2	— 3.4	— 4.6
Southern States	— 9.7	— 9.4	—10.4
Rocky Mountain	—21.7	—23.1	—22.6
Pacific	— 5.0	— 6.3	— 6.1
United States	—10.6	—10.5	—10.3

A. E. Hitchner Named as New P.C.E.A. Head

More than 600 members of the Pacific Coast Electrical Association met last week for their 21st anniversary convention in San Francisco, at which A. E. Hitchner, manager of Westinghouse Electric & Manufacturing Company's Los Angeles office, was elected president.

R. M. Alvord, retiring president, and southwest district manager for the General Electric Company, outlined the work of the association in assisting the forward march of the electrical industry in his opening address.

Dunlap D. Smalley, superintendent of San Joaquin Light & Power, told of the utility's work to effect speedy restoration of service following this year's widespread California storms. New techniques in schoolroom lighting were covered in a symposium by Dr. R. S. French, president of California's blind school; Leland Brown, Stanford University and Clark Baker, executive secretary, Northern California Sight Conservation Council.

Merchandising was treated from two standpoints. E. A. Mattison, Bank of America, pointed to the functions of bank credit in lending impetus to the movement of electrical goods. E. M. Frellson, Los Angeles merchandising manager, General Electric Supply Corporation, said that the possibility of greater profit for the dealer offered the means of incorporating the often-isolated dealer into co-operative industry endeavors.

•

Power Consumption Rises

Consumption of electric power in Texas during April made a good showing in comparison both with the preceding month and the corresponding month last year, the University of Texas Bureau of Business Research stated in its monthly report on the electric power industry. Reports from fifteen power companies representing nearly 80 per cent of the state's production of electricity show an increase in consumption of 5.7 per cent over March and 9.3 per cent over April last year. For commercial consumption the respective increases over March and April last year were 5.8 per cent and 14.3 per cent; for industrial consumption, 6.0 per cent and 7.6 per cent; and for residential consumption, 4.7 per cent and 14.5 per cent.

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First Brazos Unit to Have 20,000-kilowatt Capacity

The first unit of the hydro-electric plant which the FPC recently authorized as part of the Possum Kingdom dam and flood control project on the Brazos River will have a capacity of 20,000 kw., and will be enlarged by the installation of an additional unit of like capacity, according to the board of directors of the Brazos River Conservation and Reclamation District. The dam power plant will be financed in part by a Federal grant of $4,500,000, supplemented by bonds of the district.

•

Four Ontario Power Units Again Placed in Operation

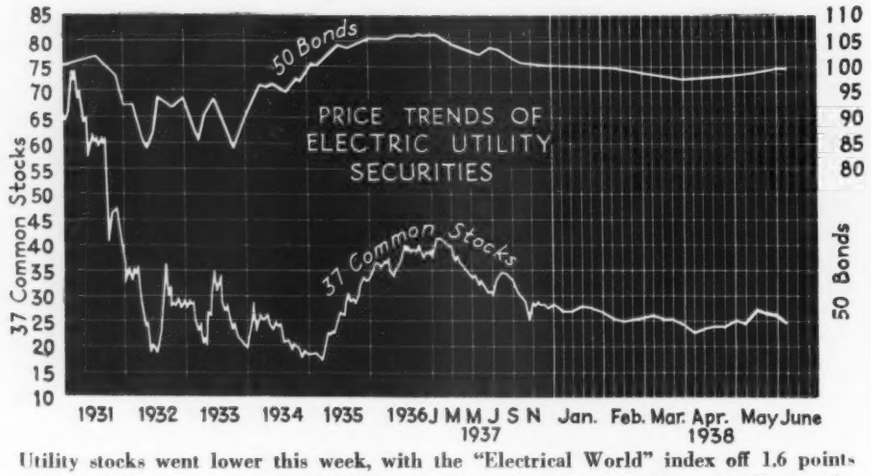
Four generating units of the old Ontario Power plant below Niagara Falls, rendered inoperative January 26 by ice and water conditions in the river, again are in operation, according to the Hon. W. L. Houck, vice-chairman of the Ontario Hydro-Electric Power Commission. The four units generate 40,000 hp. of electrical energy. Mr. Houck added that repairs to another unit, with a capacity of 10,000 hp., are practically completed and the unit likely will be available shortly. He said the plant's full capacity of 175,000 hp. probably will not be available until late in August.

•

Electric Sales in Illinois

Total sales of energy to ultimate consumers by eleven large electric utilities in Illinois amounted to 528,977,599 kw.-hr. in April, compared with 583,084,346 kw.-hr. for the corresponding month of the previous year. Despite this 9.3 per cent decrease in sales, the total was 4.2 per cent higher than the 507,460,493 kw.-hr. reported for April, 1936. Total sales during March as compared with the totals for the corresponding month last year revealed an 0.4 per cent increase in revenue, a 9.8 per cent decrease in kilowatt-hours, and a 1.9 per cent increase in the number of customers.

Stocks Lower in Week; Bonds Fairly Firm


50 Bonds
PRICE TRENDS OF ELECTRIC UTILITY SECURITIES
37 Common Stocks
37 Common Stocks
50 Bonds
1931 1932 1933 1934 1935 1936 J M M J S N 1937 Jan. Feb. Mar. Apr. 1938 May June

Utility stocks went lower this week, with the "Electrical World" index off 1.6 points to 24.8; index a year ago, 32.5. Utility bonds were comparatively steady during the week, with the "Electrical World" index rising about 0.1 point to 99.9.

Registers $2,522,000 Bond Issue with SEC

A registration statement, covering $2,522,000 of general mortgage bonds, series I, due in 1967, proceeds from which will be employed for capital expenditures, has been filed with the SEC by the Rochester Gas & Electric Corporation. The company said that in accordance with an order of the New York Public Service Commission it would deposit the proceeds with the Bankers Trust Company and expected to make application from time to time for the release of funds for capital expenditures, "made or to be made in connection with a general program of improving, adding to and enlarging its property, plant and equipment."

SEC has called for June 10 a hearing on an application by the Byllesby Corporation for an order declaring it not to be a holding company within the meaning of the Public Utility Holding Company Act.

Pennsylvania Public Utility Commission has been permitted by the SEC to intervene as a party to proceedings with reference to applications by the Edison Light & Power Company and the York Railways Company for an order declaring them not to be subsidiaries of the Associated Gas & Electric System.

The commission has issued an order declaring that the Twin State Gas & Electric Company had ceased to be a holding company. The action was taken following the company's sale of holdings of capital stock of the Berwick & Salmon Falls Electric Company, its own utility subsidiary, to the Cumberland Power & Light Company.

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Hydro License Transferred

FPC has announced its approval of the transfer of license for the Flathead project, located on Flathead Lake and River, Montana, from the Rocky Mountain Power Company to the Montana Power Company. The Flathead project, which is slated to begin commercial operation during this month or next, is stated to have an ultimate installed generating capacity of 154,000 hp.

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$19,000,000 Issues Offered by Utility

The first public financing for the San Antonio Public Service Company in ten years was undertaken last week with the offering of $16,500,000 first mortgage 4 per cent bonds and $2,500,000 of 4 per cent serial notes. The bonds, due 1963, were priced at 99 to yield 4.05 per cent, and the serial notes, due in varying amounts from 1939 to 1948, were priced to yield from 2.72 to 4.50 per cent.

Net proceeds of the sale of the bonds and notes, together with $1,960,000 to be received from the sale of 28,000 additional shares of common stock to American Light & Traction Company, a parent company, will be used to redeem $18,518,000 principal amount of bonds of the company and its predecessors bearing 5 per cent to 6 per cent coupons.

•

Commonwealth Edison Offers $33,000,000 Bond Issue

Commonwealth Edison Company first mortgage 3½ per cent bonds, Series I, were offered this week at 102¼ and accrued interest. The bonds mature June 1, 1968. Net proceeds will be applied to the redemption at 110 of $30,000,000 of first mortgage 5 per cent bonds, Series A and B, due in 1953 and 1954.

The same banking group which has underwritten the bonds is also underwriting any unsubscribed portion of a minimum of $39,083,195 of Commonwealth Edison convertible 3½ per cent debentures, due in 1958, the right to subscribe to which will shortly be offered to stockholders.

•

Investment Value Cut in Charge to Surplus

Engineers Public Service Company has made a $6,763,498 write-down in its investment account as of May 31, according to a letter to stockholders. A portion of this amount has been charged to earned surplus and the balance to capital surplus. This action reduces the book value of the investments to the cost to the company of securities and was taken after consultation with the SEC.

On May 31 the company transferred from capital surplus to preferred stock account $1,925,767. This transfer will increase preferred stock capital account to the $100 a share payable on preferred stock in the event of involuntary liquidation.

A revision also is being made in the capital surplus account by transferring $35,000,000 to a new account called reserve for depreciation in value of investments. D. C. Barnes, president, states that this reserve is being established to provide for losses the directors believe to have now accrued, though not yet taken. The principal factors causing the losses Mr. Barnes explained as increased taxes and announced intentions of public agencies to either purchase or condemn certain properties of subsidiaries or to compete with the subsidiaries.

Earnings Reports (Utilities)

	Net Income 1938	1937
*Common. & South. and subs.	$13,366,676	$15,128,029
*Minnesota Pwr. & Lt.	1,388,624	1,301,739
*The Montana Pwr. and subs.	3,205,282	3,704,278
*Florida Pwr. & Lt.	2,199,752	1,558,486
*The Washington Water Pr. and subs.	2,527,854	2,597,513
*Nebraska Power	1,913,501	1,796,314
†American Pwr. & Lt. and subs.	11,404,809	10,424,087
†Philadelphia Co. and subs.	5,319,120	6,734,361
†Associated Elec. and subs.	1,485,894	1,381,059
†Duquesne Light	9,663,916	10,236,051
†Northern States Pwr. (Del.) and subs.	5,984,740	5,251,257
†International Hydro-Elec. and subs.	1,856,492	1,443,334

* Twelve months ended April 30.
† Twelve months ended March 31.

Utility's Taxes Are $14,855,452 in 1937

While Electric Power & Light received $1,809,033 from the earnings of its subsidiaries in 1937, governmental bodies took $14,855,452, or eight times as much, in the form of taxes, according to the annual report, signed by Joe H. Gill, president.

Consolidated operating revenues of subsidiaries last year totaled $109,369,229, an increase of $12,629,998, or 13 per cent over the previous year, and included electric energy sales amounting to $47,726,234, an increase of 11 per cent over 1936. Consolidated operating expenses, including taxes, were $57,789.625, an increase of $6,491,172, or nearly 13 per cent, Mr. Gill stated. Balance carried to consolidated earned surplus of the corporation was $9,727,530, against $7,748,913 in 1936.

Last year the subsidiaries spent more than $30,000,000 for extensions, improvements, property acquisitions and developments, Mr. Gill said. Dallas Power & Light Company is building a steam-generating plant to have an initial capacity of 31,250 kw., a new substation and some 17 miles of 60-kv. transmission lines to connect with the existing steam plant in Dallas; all of this is scheduled for initial operation by July this year. New Orleans Public Service is proceeding with the installation of an additional 30,000 kw. of generating capacity in its Market Street generating station.

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Westinghouse Centralizes Air-Cleaning Activities

Following five years of intensive research and experimentation in electrically precipitating dust out of the air, Westinghouse Electric & Manufacturing Company is centralizing the manufacture and sales of its "Precipitron" in its Cleveland, Ohio, division. F. R. Kohnstamm, manager of the Cleveland division, which also produces all Westinghouse lighting equipment, will supervise all activities in connection with this newest air-cleaning development. George F. Begoon has been appointed sales manager. He was formerly with the new product division in East Pittsburgh.

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Greenfield Contract to G.E.

Board of Public Affairs, Greenfield, Ohio, has awarded a contract to General Electric Company for a turbo-generator unit and auxiliary equipment for installation in municipal power station, where expansion will be carried out. The award includes feeder panels, generator and regulator panels and complete accessories. A contract has been let to Ingersoll-Rand Company, New York, for a condenser unit for the new generator installation. An award for construction of an addition to the present power plant will be made at later date.

•

Operating Revenues Drop 9% in Quarter

Net operating revenues reported by American & Foreign Power subsidiaires for the first quarter were $4,639,844. a decrease of $482,007, or 9 per cent, from the same period last year, according to the 1937 annual report, signed by C. E. Calder, president.

Contributing factors to this decrease were the Sino-Japanese conflict, which reduced net operating revenues of the Shanghai companies $595,844, plus the present unfavorable trend of exchange rates, which cut revenues of the other subsidiaries $126,493, the report stated. In spite of this adverse exchange factor, however, these companies showed a gain in net operating revenues for the first quarter of $113,837.

Last year the balance of consolidated income, after interest and other charges, but before exchange adjustments, was $6,153,093, against $5,060,447 in the previous year, Mr. Calder reported. An increase of 7 per cent was shown in customers served, 1,192,813 out of the total of 1,258,498 receiving electric service. Output of electricity, including purchased power, totaled 3,031,846,000 kw.-hr. in 1937, against 2,986,848,000 the previous year.

Construction expenditures in 1937 amounted to $9,109,633, all of which were financed with funds provided from operations. At present a 22,500-kw. steam-generating station is under construction at Laguna Verde in Chile and is expected to be put in operation about October this year. Several smaller units are also being built.

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Grand River License Asked

Grand River Dam Authority, Vinita, Okla., has filed with the FPC application for license for the large power project to be constructed near Pensacola, Okla. The proposed project includes a power house immediately below the dam with installed capacity of 80,000 hp. in four units, with provision in the power station for two future units and the necessary transmission lines for the distribution of energy to available markets.

Makes Provision for Increased Demands

The Duke Power Company will be prepared to provide for an increase of 10 per cent in electric energy consumption on its lines in North Carolina and South Carolina when the large addition to the Riverbend steam-electric plant near Charlotte, N. C., is placed in service soon, said Charles I. Burkholder, vice-president and chief engineer.

Mr. Burkholder stated that the company will continue its well-known policy of watching the industrial and commercial expansion of the Carolinas and additional power-producing facilities will be provided in advance of the need. He announced that the test runs at the $3,000,000 addition would start early this month.

The new addition is rated at 75,000 hp. and increases the capacity of the Riverbend development to 225,000 hp. in three production units. The first two units were placed in service in 1931.

•

Refers Federal Power Act Revision Back to Committee

After considerable debate the Senate has rescinded its previous action approving an amendment to the Federal Power Act and referred the measure back to the judiciary committee for further consideration. Introduced by Senator Bailey of North Carolina, the bill would permit an appeal to the courts by any person, state or political body aggrieved by an order or finding of the Federal Power Commission. As now worded the Federal Power Act limits the right of appeal to those who have been parties to the proceedings, and then only as affects formal orders.

•

Wall Lamp Campaign Closed

Results of a wall lamp campaign of the La Salle Lighting Products, Inc., Buffalo, N. Y., have been announced by R. E. Williams, sales manager of the Wisconsin Michigan Power Company of Appleton, Wis. The campaign started February 15 and ended March 31. The quota for the campaign was 2,000—the actual number sold was 2,417. There were 279 employees eligible, of which 61 per cent, or 170, participated. The average sale for each employee participating was 14.2 lamps and the total lamps sold represent 21.3 per cent of the meters. The lamps were sold at full retail price and each lamp was equipped with a diffusing bowl using a 100-watt bulb.

Heating Engineers Announce Program

Tentative program for the summer meeting of the American Society of Heating and Ventilating Engineers to be held at The Homestead, Hot Springs, Va., June 20–22, recently announced, lists ten technical papers and an extensive program of entertainment.

The council of the society will hold its semi-annual meeting on June 19. A meeting of the society's committee on research, of which W. L. Fleisher of New York is chairman, will be held in connection with the technical sessions.

Among the papers to be read are the following: "Heat Transfer Through Single and Double Glazing," by M. L. Carr, R. A. Miller, Leighton Orr and Alan C. Byers; "Performance of Surface Coil Dehumidifiers for Comfort Air Conditioning," by G. L. Tuve and L. T. Seigel, and "The General Reactions of 275 Workers to Summer Cooling and Air Conditioning," by A. B. Newton and F. C. Houghten.

•

Ajax Shows High-Frequency Furnace at Franklin Institute

An exhibit showing the heating effect of induced high-frequency currents is among those recently opened to the public at the Franklin Institute in Philadelphia. All parts of the equipment for generating the current are visibly arranged in a glass case, enabling the observer to trace the circuits, and, as he pushes a button, to see just what happens during the heating cycle.

A note on the exhibit states that induction furnaces of 8 tons capacity are in regular operation producing steel, while approximately 100,000 kw. of energy has been installed for inductive melting, differential heating, surface hardening and other heat-treating operations. Exhibit is a donation of the Ajax Electrothermic Corporation of Trenton, N. J.

•

General Electric "Oldsters" Have Long Service Records

Celebrating this year its 60th anniversary of electrical progress, General Electric had on its payroll at the end of 1937 a total of 46 employees whose continuous association with the organization go back almost to the date of its inception.

Oldster of the veterans is C. J. Leephart, central station department, Schenectady, who has been continuously employed by the company for 55 years. R. S. McNeil, appliance and merchandise department, Bridgeport, and C. N. Mason, president of the Electrical Securities Corporation and G.E. Employees Securities Corporation, wholly owned associate companies of General Electric, each has 50 years of service. Others in the "oldster" group have service records of 45 years or more.

•

Byllesby Inquiry Ended

The Wisconsin Banking Commission has taken under advisement the state's request that the 1938 securities license of H. M. Byllesby & Company be revoked.

Meetings

Edison Electric Institute—Annual convention, Atlantic City, N. J., June 6–9. Bernard F. Weadock, managing director, 420 Lexington Avenue, New York, N. Y.

Public Utilities Advertising Association—Annual convention, Detroit, Mich., June 12–15.

Wisconsin Municipal Utilities Association—Annual convention, Marshfield, Wis., June 16–17. J. J. Jedwabny, secretary, Menasha, Wis.

Society of Chemical Industry — Annual meeting, Ottawa, Canada, June 20–22.

American Society of Heating and Ventilating Engineers—Summer meeting, The Homestead, Hot Springs, Va., June 20–22. A. V. Hutchinson, secretary, 51 Madison Avenue, New York, N. Y.

American Society of Mechanical Engineers—Semi-annual meeting, St. Louis, Mo., June 20-24. C. E. Davies, national secretary, 33 West 39th Street, New York, N. Y.

American Institute of Electrical Engineers—Summer convention, Washington, D. C., June 20–24. Pacific Coast Convention, Portland, Ore., August 9–12. H. H. Henline, national secretary, 33 West 39th St., New York, N. Y.

Canadian Electrical Association — Annual convention, Seigniory Club, Province of Quebec, Canada, June 22–24. B. C. Fairchild, secretary, 804 Tramways Bldg., Montreal, Que.

National Electrical Credit Association—Annual convention, Hotel Statler, Detroit, Mich., June 23–24.

Economics Conference for Engineers—Annual meeting, Stevens Engineering Camp, Johnsonburg, N. J., June 24–July 2.

American Society for Testing Materials—Annual meeting, Calfonte-Haddon Hall, Atlantic City, N. J., June 27–July 1. H. E. Hess, assistant secretary, 260 South Broad Street, Philadelphia, Pa.

American Association for the Advancement of Science — Summer meeting, Ottawa, Canada, June 27–July 2.

World Power Conference—Vienna sectional meeting, August 25–September 2. Executive committee, U. S. National Committee, World Power Conference, 4 Irving Place, New York, N. Y.

Illuminating Engineering Society—Annual convention, Nicollet Hotel, Minneapolis, Minn., August 29–September 1. A. D. Cameron, general secretary, 51 Madison Avenue, New York, N. Y.

Indiana Electric Association—Annual convention, French Lick, Ind., September 29–October 1. Tom C. Polk, secretary, 607 Traction Terminal Bldg., Indianapolis, Ind.

Puerto Rico Fails to Vote Power Bill

The Puerto Rican Legislature adjourned recently without voting on the Administration's "Little TVA Bill" to create a Water Resources Authority with a proposed $10,000,000 insular government corporation. The authority, under the terms of the bill, would take over the present properties, activities and obligations of the existing insular agency for utilization of water resources, which has developed government irrigation services, hydro-electric power and a distribution system.

The bill empowered the authority to acquire and operate revenue-producing undertakings and to continue to completion development of the island's water resources, accept grants and loans from the United States or any agency or instrumentality thereof, and to issue bonds up to $10,000,000 for not longer than 50 years at 5 per cent. These bonds would be tax exempt and the property acquired would be non-taxable.

Another measure on which action was not taken was the bill giving the government the right to purchase the Rio Blanco hydro-electric plant from the Puerto Rico Railway, Light & Power Company, a Canadian-owned company operating under a franchise.

•

International Engineering Group to Meet in Glasgow

The International Engineering Congress is to meet at Glasgow, Scotland, June 21-24, in the conference hall of the Empire Exhibition, Scotland, 1938, which opened this month and will continue until October.

A program of technical sessions, inspection trips to various industries and excursions has been arranged. Technical sessions will be held during the mornings of June 21 and 22 and will include a series of fifteen addresses by outstanding British and other engineers dealing with various branches of engineering.

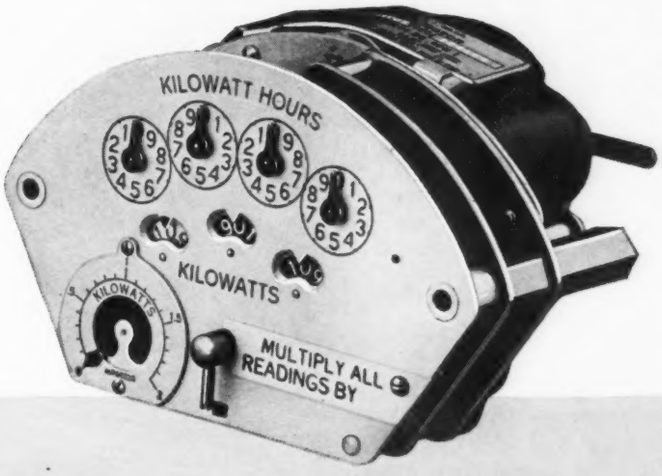
•

Porcelain Enamel Forum

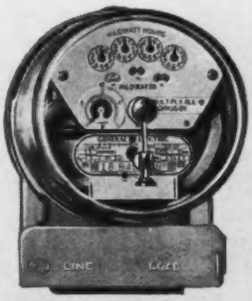
The committee for the third annual forum of the Porcelain Enamel Institute met recently in Chicago to organize a preliminary program after receiving 200 suggestions on material for the forum from those who attended the first two. F. E. Hodek, Jr., General Porcelain Enameling & Manufacturing Company, is chairman. Other members of the committee include Dr. A. I. Andrews, University of Illinois; Prof. R. M. King, Ohio State University, and J. E. Hansen, Ferro Enameling Corporation.

TAKE FULL ADVANTAGE OF DEMAND METERING

With this G-E Cumulative Register



It combines the verifying features of a recording device with the low cost of an indicating register



Type IM-30
The I-30 watthour meter with the M-21 demand register

IT'S A HIGH-TORQUE LOW-SPEED METER

These characteristics of G-E meters result in long-time accuracy on widely varying loads.

THIS G-E Type M-21 register does a thoroughly complete job of demand metering. Not quite the job of a recording device, but enough to give it advantages that warrant consideration on the basis of economy. See what they are and how they profit you.

How the M-21 verifies

The M-21 preserves the last reading, so that at any time during the ensuing month it is available for verification. It also adds, cumulatively, the monthly maximum demands. It thus puts the work of reading and recording data on the same basis as regular kilowatt-hours.

What you have is proof—definite evidence—by means of which you can show a customer just what is his maximum demand of the month. This is added help in building—and maintaining—good will. You are *sure*.

Savings in other ways

First cost is low; and you also save on installation. The M-21 goes right on a meter in service, which needs simply a deeper cover, and requires no extra wiring. It saves time and space; and you have a *single* tamperproof unit. Maintenance costs little; testing is simple and sure—and you can always trust the M-21 for accuracy.

When you look into this register, study its fine performance record, and get figures on its low cost; then you can see how it enables you more fully to take advantage of demand metering. A G-E meter specialist will be glad to help. Call or write nearest G-E sales office, or General Electric Company, Dept. 6-201, Schenectady, N. Y.

GENERAL ELECTRIC

410-48

Field OPERATING PRACTICES

New ideas and practices in the operation of well-designed, constructed and maintained plants and systems

Field Test Set Has Wide Range

The universal test set shown in the accompanying illustration was constructed in the electrical testing laboratory of the Milwaukee Electric Railway & Light Company for use in the investigation of certain types of electrical phenomena where advance information of existing conditions is not available. Ordinarily in the investigation of such cases it is necessary to carry along several portable instruments so that one of the proper range will be available. To avoid this inconvenience the illustrated wide-range universal test set was designed for use as a portable field instrument. The test set includes instruments and instrument circuits suitable for electrical measurements in the following ranges:

A.C.		D.C.		Ohmmeter,	A.C. Bridge Arrangement
Volts	Amp.	Volts	Amp.	Ohms	Ohms
0.15 to 2,300	0.1 to 1,000	0.002 to 2,500	0.050 to 150	100 to 250,000	1 to 10,000

•

Organized Procedure Speeds Load Surveys

By GLEN E. CORNISH
Iowa Electric Light & Power Company
Cedar Rapids, Iowa*

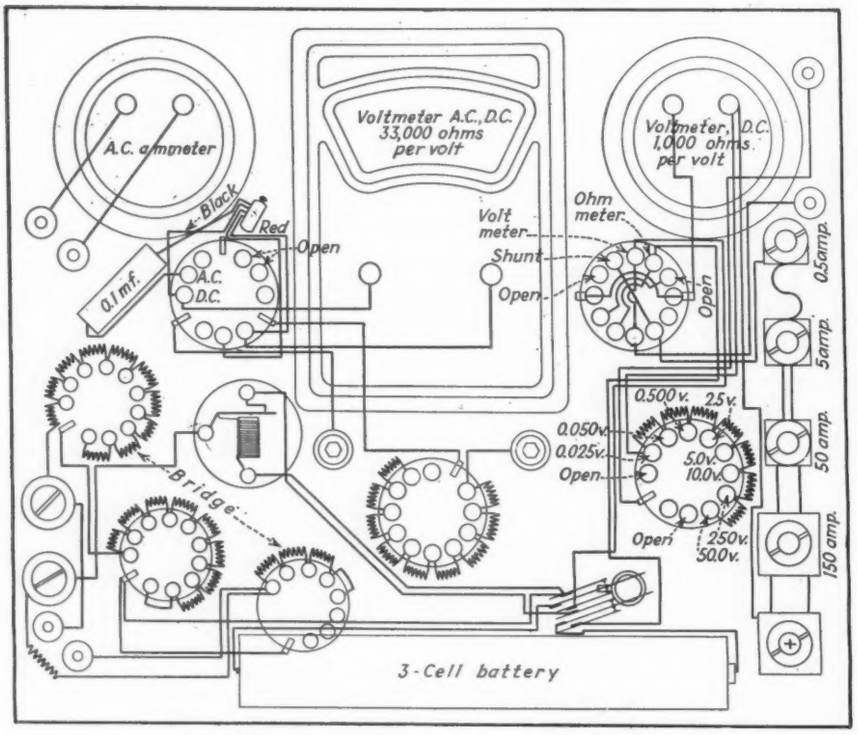
Out of several years experience in surveying voltage and load conditions on distribution systems has come a routine that speeds collection and analysis of data for the Iowa Electric Light & Power Company. Before beginning a distribution system voltage and load survey, maps must be prepared showing primary and secondary lines, meter readings and other data at the points where they obtain. The most satisfactory map scale is 200 ft. per inch.

Feeder conductors are phased out from the substation and a one-line diagram made of the primary system, with the conductor positions shown by number or letter. Such data as wire sizes, spacing, transformer locations, transformer sizes and numbers, positions of conductors at corners, special load connections, and transformer phase connections are recorded.

The usual set-up of instruments on a three-phase, regulated feeder at the substation would be a graphic voltmeter on each phase of the regulated bus, a graphic ammeter in each conductor of the feeder and a three-phase graphic wattmeter in the feeder. Graphic voltmeters are installed at ends of three-phase primaries, at ends of long single-phase branches. Graphic instruments at the substation and on the feeders are allowed to run over the various peak periods, usually from Friday to Wednesday.

While this first, or "as found," primary set-up is recording load conditions, the secondary mapping is started from the transformer nearest the substation. Data are set down on the field map as follows:

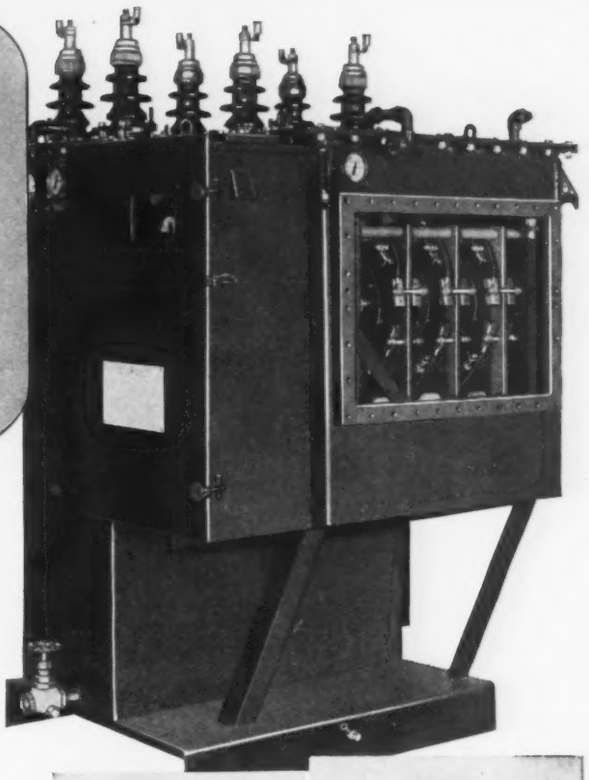
1. All poles carrying secondary lines and services are shown.
2. Transformers, with their numbers and capacities noted, are designated at their respective pole location in sequence outward.
3. A one-line secondary diagram is



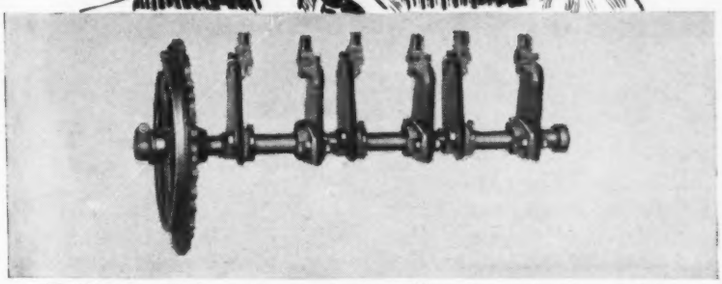
Portable meter meets almost any test condition

* From paper to Sales and Distribution School, Iowa Public Utilities Association.

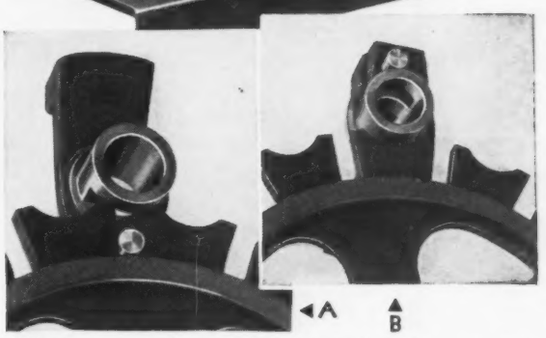
Here's why I always specify G-E Station-type Step Regulators



G-E station-type step regulator with cover plate removed to show switching mechanism



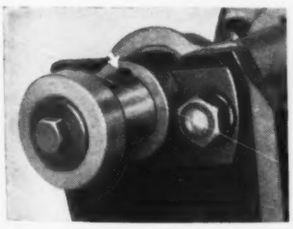
1 With the G-E switching mechanism, all moving contacts are rigidly mounted on a SINGLE SHAFT. This simple construction gives maximum strength of assembly and assures positive, accurate alignment of all contacts on all three phases simultaneously.



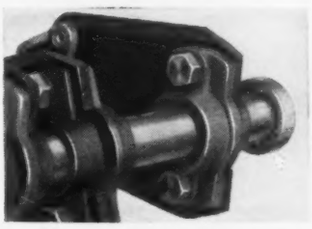
2 The switch shaft is driven through a Geneva gear. Positioning of the switch is positive and does not depend on latches or brakes.

(A) The driving pin, passing between adjacent teeth of the Geneva gear, positively controls its position throughout the motion from one tap position to the next.

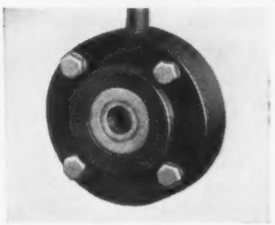
(B) After each revolution, the sleeve of the Geneva gear driver engages the center of the gear tooth, locking shaft in position.



3 All moving contacts and gears which work under heavy mechanical stress are keyed to their shafts. Keyed fastenings will not shear. They contribute to faultless operation and reduced maintenance.



4 Ball bearings are used throughout the driving mechanism, including the switch shaft which operates under oil. This results in the minimum of friction and in long bearing life.



5 A practically friction-less mercury seal prevents passage of oil along the shaft connecting the mechanism in the control compartment to the oil-immersed tap-changing switch.

6 The power springs are fastened to the anchoring lugs without any kinks or bends which might result in weak points. As a result, the springs will give long service under the severest operating conditions.

Many power companies have found G-E 3-phase step voltage regulators a low-cost means of improving voltage conditions. General Electric's Bulletin GEA-1577D will tell you all about these regulators. Ask your G.E. representative for a copy or write General Electric Company, Schenectady, New York.

GENERAL ELECTRIC

350-140

made showing the number and sizes of wires.

4. All customers are shown in their positions on the plot.

5. All services are shown by one line with notations for three-wire services. Customers having electric ranges are circled in red. All other large appliances are noted.

6. As the mapping of each unit of secondary or interconnected secondaries is completed, test locations are selected at the various secondary ends and numbered consecutively.

One graphic voltmeter, installed on the transformer pole, with potential transformer connected at the cutouts, will serve as a primary reference for each group of secondary charts.

As each secondary unit is mapped, graphic voltmeters are set at the test locations and allowed to run at least 24 hours. Each chart is stamped with a chart identification stamp and all data are written in. Evening or day peak loads of transformers are checked and written in on the secondary field map. Most of the load tests are made with a split-core current transformer and indicating ammeter.

Finished maps showing conditions "as found" have been started and when these are completed all data are available for the study of secondary conditions. Recommendations, to make necessary corrections on these secondaries, are now made, mapped in duplicate, and, after approval by department heads, are turned over to the local distribution superintendent.

During the course of the survey ratio tests are made on all distribution transformers to detect any "off" ratios or incorrect tap settings. This is done by simultaneous voltage readings on primary and secondary. If examination of the graphic ammeter charts from the substation shows an unbalanced condition it is now an easy matter to decide what load, referring to the transformer load tests, to shift from one phase conductor to another to bring about the required feeder balance. A voltage gradient diagram showing "as found" conditions and one showing "as left" conditions is made up.

Equipment for Distribution System Survey

Panel type truck of ¾-ton capacity, with built-in compartments so arranged that the instruments are handy to cab or rear doors.

12 or more graphic voltmeters, 90–140 and 180–280-volt scale, strip chart, electric clock drive.

3 graphic ammeters, 5 amp., strip-chart, electric clock drive.

1 graphic wattmeter, 5 amp., 110 volt, strip-chart, electric clock drive.

4 graphic ammeters, with split-core current transformers, 100/200/300 amp., strip-chart, spring clock drive.

1 indicating ammeter with split-core transformer, good quality, 35/125/250 amp. scale.

2 portable voltmeters, good quality, 150–300 volt scale.

1 multi-range ammeter, high grade, 2 to 150 amp. range.

1 voltmeter, high grade, 150–300 volts, for calibrating purposes.

1 slide wire rheostat for calibrating purposes.

6 2,300-volt outdoor type potential transformers.

3 6,600-volt outdoor type potential transformers.

Complete set leads for above instruments.

1 50-ft. piece of 600-volt duplex rubber-covered cord.

1 35-ft. piece of 7,500-volt, two-conductor cable, with reel.

2 7,500-volt cutouts.

1 pair of insulated (7,500-volt) probe terminals.

1 1.5-kva. auto-transformer, 110/220 volt, for experimental purposes.

1 3-kva. auto-transformer, 110/220 volt, for experimental purposes.

2 pole boxes, to house three-phase voltmeter set-up.

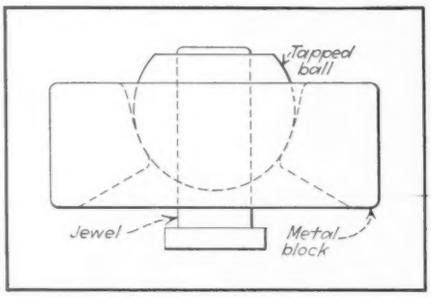
6 pole boxes, to house single-phase and ammeter set-up.

1 portable drawing table and set of drawing instruments.

•

Simple Scheme Aids Jewel Inspection

Microscopic examination of meter jewels is greatly facilitated by the provision of means by which the surface of the jewel can be turned and tilted under the lens without moving it greatly, or at all, out of focus. A simple way of accomplishing this is in use in the meter department of the Union Electric Company of Missouri in St. Louis. The object bed of the microscope consists of a metal block machined as is indicated in the accompanying sketch. In the socket of the block rests a

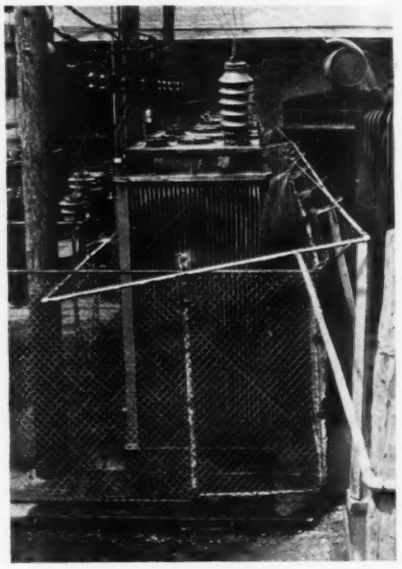


Microscope bed for meter jewels

small steel ball which is drilled and tapped to receive the jewel screw. By movement of the screw head below the block the jewel surface may be moved about as may be desired. Tapped balls are provided for the different types of jewels used by various meter manufacturers.

Emergency Cooling Saves Transformers

When an exceptionally hot summer day raises the temperature of six overloaded 1,000-kva. transformers well above the danger point emergency cooling methods are in order. Under such conditions engineers of the Danbury & Bethel Gas & Electric Light Company reduced



Water spray cools power bank during emergency

the temperature of a bank at Pahquioque station between 20 and 30 deg. in a very short time with a water spray system that took four hours to build.

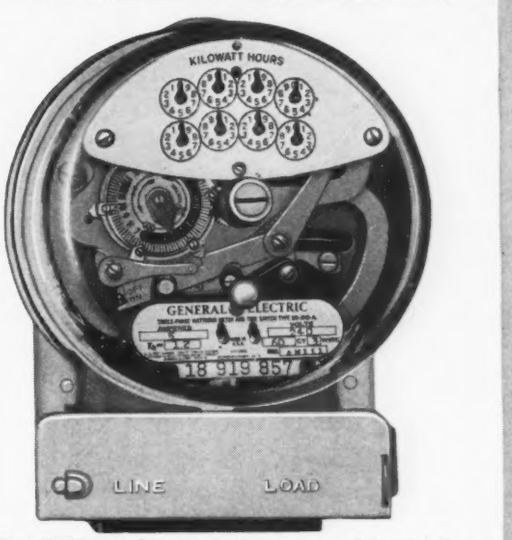
Between 1 and 5 o'clock in the afternoon a closed rectangular loop of 1½-in. pipe was built around the transformer bank and equipped with tee connections, sill cocks and garden hose nozzles, as shown in the accompanying illustration, to spray water on all four sides of each of the transformers. Water was supplied to the loop through a 2-in. pipe. Adjacent sides of the transformers were reached with projections of ¾-in. pipe between the units. The sill cocks, attached to each tee in the loop, served the double purpose of permitting the flow of water to the nozzles to be adjusted and took care of the difference between the pipe threads on the tee and the thread on the hose nozzles.

The bank, which has since been replaced with larger transformers, was sheltered by surrounding buildings in such a way that adequate air circulation around the bank was difficult.

FOR LOW-COST CONTROL OF WATER-HEATER LOADS

Presenting a NEW *addition to the* Wide-Limit Family

The IR-30 Combination watthour meter and time switch



Type IR-30-A combination watthour meter and time switch for front connection. The Type IR-30-S for socket mounting is also available

THIS new G-E meter marks another progressive step in the direction of lower-cost control of off-peak loads.

It combines in a single unit the I-30 watthour meter, with its straight-line accuracy between far-apart limits, and an improved Telechron motored time-switch register.

New Lower Costs—Savings in space, savings on installation, maintenance, and inventory investment—these are the advantages of a single unit. Now, add to them the wide-limit accuracy of the I-30 watthour meter, which makes it suited for both large and small single-phase loads, and you can see the way to still lower costs and further protection of revenue.

For any job—Available in all ratings, with any one of three registers—single-dial, with contacts; double-dial with contacts; and double-dial without contacts—the IR-30 meter is suited for any load-control job.

More details—"We've got something" in this new meter, and it will pay you to see what that something is and how it profits you. A G-E meter specialist is ready to tell you all about it, and you can reach him through the nearest G-E sales office or address General Electric Company, Dept. 6—201, Schenectady, N. Y.

GENERAL ELECTRIC

400-32

Industrial ELECTRIFICATION

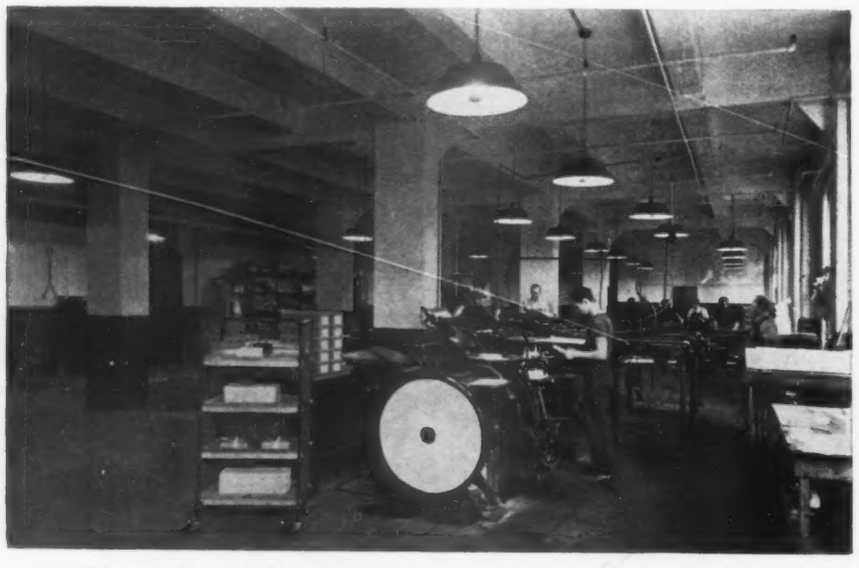
New ideas and practices in industrial electrification as presented by industrial, consulting and power sales engineers

Lighting Facilitates Printing Operations

Relocation of the New York City Press was made the occasion for the installation of modern lighting equipment to provide the quality of illumination that painstaking printing operations require. It was desirable to have shadow-free illumination on the type racks, composing stones and presses and a quality that would permit color discrimination to a limited extent, although little color work is done at this plant.

Twenty-nine ceiling pendant chain drops fitted with 21-in. diameter. Silvray wide-angle industrial reflectors were installed and fitted with 200-watt, 120-volt silvered bowl, inside-frosted Mazda lamps. Mounted 8 ft. 6 in. from the floor and spaced approximately 7 ft. 6 in. x 8 ft. 6 in. on centers, these direct-indirect units provide an average intensity of about 25-ft.-candles. Average wattage density is 3 to 4 watts per sq.ft.

The management of this company reports that the lighting installation has reduced eye strain appreciably and made it possible to increase production from 5 to 10 per cent.



Direct-indirect lighting increases printing plant production from 5 to 10 per cent through reducing eye strain

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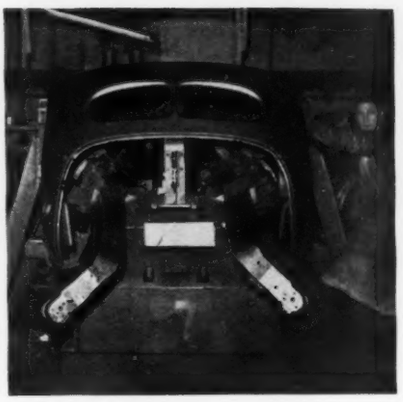
Arc Welding Saves Over Spot Welding

Savings of $3 per body are obtained by the Hudson Motor Car Company, Detroit, Mich., by use of plain butt welding with the electric arc process in place of conventional spot welding and soldering, according to data just released by Hudson officials. Although the information is just being disclosed, the method has been in use for three years and has been employed in fabricating hundreds of thousands of bodies.

Plain butt welding of Hudson bodies is done in jigs. The roof panel and rear quarter panel are clamped in position with the edges of the panels abutting. Two arc welding operators, working on the inside, apply metal in one pass of the electrode, obtaining complete penetration through the joint, thus virtually eliminating the need for filling the outside of the seam with solder.



Welding jig speeds auto assembly
Plant using plain butt welding by the electric arc process saves $3 on every body.

One dollar's worth of solder is saved per body, since the electrically welded seams require only slight tinning to assure smoothness for finishing. The total saving of $3 includes saving in cost of solder plus the various operations of tinning, forming, removing excess solder and polishing the surface for finishing. The welding is done with "New Lightweld" electrodes made by the Lincoln Electric Company, Cleveland, Ohio, especially for welding thin gage metal. The joint is approximately 18 in. long on the sedan and 36 in. long on the coupe extending from a point adjacent to the rear window to the trunk opening. There are, of course, two of the joints per body, one on either side.

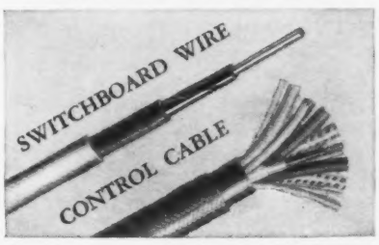
A LOT DEPENDS ON A *Well Wired* SWITCHBOARD

Power, Lighting, Satisfied

Think of the things your switchboard does. It assures the proper distribution of energy for power and lighting. It takes care of your customer's wants—protects your profits. To make sure of its dependability, wire it with Deltabeston.

First of all, specify Deltabeston Switchboard Wire. It is flexible—easier to install. Purified Asbestos insulation does not crack or break—even on right-angle bends. Installations are neater—far more dependable.

DELTABESTON



Customers and Profits . . .

Then, for the connection of control circuits, use Deltabeston Station Control Cable. Purified Asbestos and Varnished Cambric provide ample protection against heat, moisture, oil and grease. Together, Deltabeston Switchboard Wire and Deltabeston Control Cable will guard the long life and faithful service of your equipment.

A complete line of Deltabeston Wires and Cables are distributed by General Electric Merchandise Distributors and Graybar Electric Company. For information, write to Section Y-8162, Appliance and Merchandise, Dept., General Electric Co., Bridgeport, Conn.

GENERAL ELECTRIC

DELTABESTON WIRE AND CABLE

APPLIANCE AND MERCHANDISE DEPARTMENT, GENERAL ELECTRIC COMPANY, BRIDGEPORT, CONNECTICUT

New ENGINEERING IDEAS

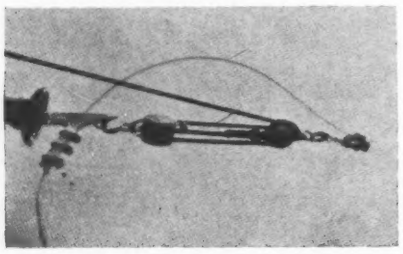
Discoveries, proposals and developments by electrical engineers and scientists in the field, the factory and the laboratory

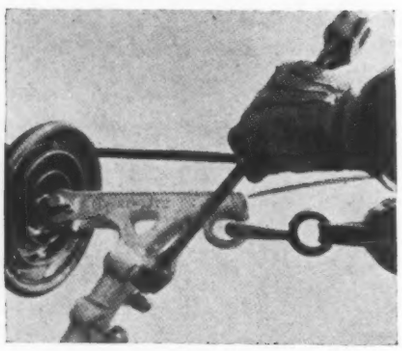
Strain Clamp Loop Aids Wire Sagging

By J. J. TAYLOR
Development Engineer
Ohio Brass Company, Mansfield

In pulling up small conductors for anchorage in a strain clamp it is common practice to use "blocks" for securing proper tension. The conventional method of block anchorage for this operation requires that a rope or wire sling be placed around the pole, or around the crossarm if dead-ending on the arm. With this method the line of pull is not coincidental with the final conductor position. For this reason the conductor must be pulled up somewhat in excess of the subsequent span tension to compensate for the excessive slack.

To eliminate this problem the Ohio Brass Company has added a loop under the nose of its small "Hi-Lite" strain clamp, the one which accommodates 0.40 to 0.55-in. conductors when unlined and 0.30 to 0.45-in. conductors when furnished with liners. The loop is an integral part of the clamp body casting and has ample strength for any tensions to which it may be subjected.



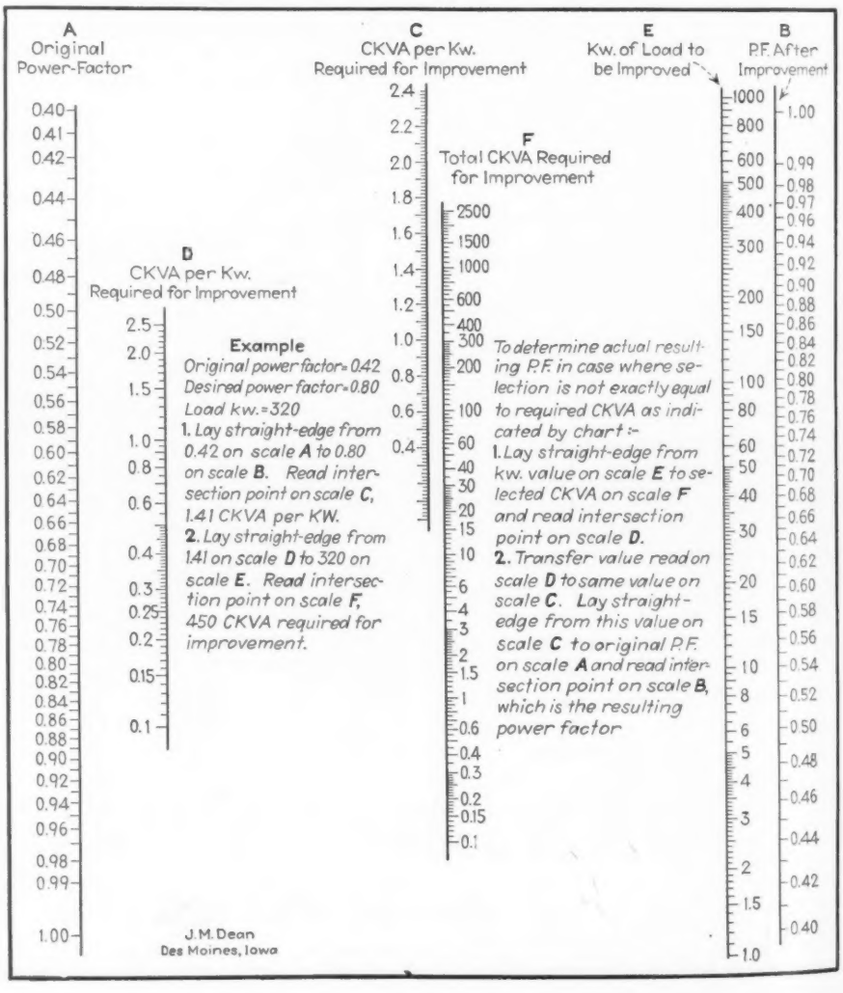


Loop in strain clamp an innovation that aids sagging

With the tail block hook in the loop on the strain clamp (as above) the dead-end assembly assumes a position in line with the conductor. It is not necessary to compensate for slack between the come-along and clamp when the conductor is up to proper tension (below).

CHART SOLVES POWER FACTOR PROBLEMS

Nomogram determines: 1. Capacitor kva. required for power factor improvement; 2. Power factor improvement resulting from given capacitor kva.


A
Original Power-Factor
C
CKVA per Kw. Required for Improvement
E
Kw. of Load to be Improved
B
P.F. After Improvement
F
Total CKVA Required for Improvement
D
CKVA per Kw. Required for Improvement
Example
Original power factor = 0.42
Desired power factor = 0.80
Load kw. = 320
1. Lay straight-edge from 0.42 on scale A to 0.80 on scale B. Read intersection point on scale C, 1.41 CKVA per KW.
2. Lay straight-edge from 1.41 on scale D to 320 on scale E. Read intersection point on scale F, 450 CKVA required for improvement.
To determine actual resulting P.F. in case where selection is not exactly equal to required CKVA as indicated by chart:-
1. Lay straight-edge from kw. value on scale E to selected CKVA on scale F and read intersection point on scale D.
2. Transfer value read on scale D to same value on scale C. Lay straight-edge from this value on scale C to original P.F. on scale A and read intersection point on scale B, which is the resulting power factor
J.M. Dean
Des Moines, Iowa

WORKING PLATFORM OPENS *and* FOLDS AUTOMATICALLY

A convenient, safe footing is automatically provided as inner section is extended. When section is lowered, platform automatically collapses.

A multiplicity of working positions is offered the operator of a Crowsnest—from the guarded, stable footing of the platform. There are 10 angles of inclination—360° rotation.

Excellence in design, materials and manufacture are the reasons why hundreds of Crowsnests are in use by the electrical industry.

The remarkable flexibility of the Crowsnest allows for servicing high and low street lights, lights on mast arms and center span lights, trimming trees and line inspection.

Give your men a Crowsnest—it's the proper tool—maintenance expense will be a minimum. Write now for Bulletin 102.

METROPOLITAN DEVICE CORP., BROOKLYN, N. Y.

MURRAY CROWSNEST

Building Up THE LOAD

New ideas and practices in selling electrical equipment and service to commercial and domestic customers

Painted Windows Aid Light Distribution

In few concerns are the demands for numerical accuracy greater than in a bank. A single slip in calculating may mean hours of extra work. Thus the lighting job engineered by Westinghouse Electric & Manufacturing Company for the First National Bank of San Francisco is paying dividends—by increasing the speed and accuracy of those engaged in book-keeping.

Unpainted windows tried

A surprising piece of evidence grew out of a request by employees that windows in one department be left unpainted—opaquing windows, then coating them to match the walls, was standard elsewhere on the job. With the new lights in service, it was found in this department with unpainted windows that on dull days intensities next to the windows dropped to 18 ft.-candles, while the prescribed 30 ft.-candles was maintained near windowless walls.

When the windows were subsequently painted over the 30-ft.-candle level was restored throughout.

Prior to the modernization the rooms involved were naturally lighted through windows which faced on a central court. So unfavorable was this source that extremes of 5 and 100 ft.-candles were measured on opposite sides of the same adding machine, while obsolete lighting fixtures created bright spots in the plane of vision, adding to eye strain, fatigue and discomfort.

Replacing these sources are 300-watt Magnalux luminous bowl indirect units spaced on 9-ft. centers. To assist these in producing virtually shadowless illumination ceilings and upper wall surfaces were painted with a flat cream finish having 82 per cent reflection factor. Windows coated as described are opened slightly at top and bottom for ventilation.

Installation pleases employees

Engineered by K. K. Knopf of Westinghouse and supervised by Raymond Bradley, electrician for the bank, the installation has met with the unqualified praise of employees. More than 100 fixtures were placed in bookkeeping and transit rooms and further units are being added in recreation and dining quarters for employees.

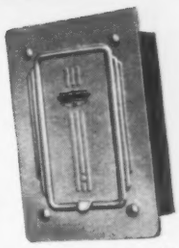
Employees in bookeeping and transit rooms of First National Bank, San Francisco, are provided with lighting intensity of 30 ft-candles

More Economical and Adequate Wiring for Low Cost Homes

THE CUTLER-HAMMER TRI-BRANCH FUSER

It's New — AND THERE'S NOTHING ELSE LIKE IT!

The New Cutler-Hammer Tri-Branch Fuser was designed to fit the trend toward more economical, adequate wiring in low-cost home programs. The diagram tells the story. It gives added branch circuits, fuse-protected, for every floor on which it is used, in the most economical manner. It's a business creator and a load builder, another memorable Cutler-Hammer advance, typical of the way Cutler-Hammer meets market demand just when the demand is piling up. The Tri-Branch Fuser is in line with the trend toward greater convenience, greater attractiveness, greater economy and service. There is nothing else like it on the market today . . . and that means opportunity for wide-awake men in the domestic electric field. Everybody gains with the new C-H Bulletin 4385 Tri-Branch Fuser. CUTLER-HAMMER, Inc., *Pioneer Electrical Manufacturers*, 1313 St. Paul Avenue, Milwaukee, Wisconsin.



CHECK THE FEATURES OF THIS BUSINESS BUILDER

1. Provides 3 fuse-protected circuits in each unit.
2. Exceptionally low cost provision for more adequate wiring.
3. Big market in homes standing and homes to be built. A load builder. Because it provides adequate wiring, it may open way to other sales.
4. Easy, economical to install.
5. Quality engineered construction. Compact, measuring only 6¼" x 4⅛" x 2¾". Styled cabinet, finished in aluminum.
6. Designed for flush mounting with convenient mounting bracket.
7. Size, convenience, appearance and low cost have great user appeal.

THE SUCCESS OF A COMPANY CAN ONLY REFLECT THE SUCCESS OF ITS PRODUCTS

CUTLER-HAMMER
SERVICE CONTROL
C-H

New EQUIPMENT AVAILABLE

Strain Clamp

To simplify the job of dead-ending small conductors, a loop has been added under the nose of this strain clamp, making it

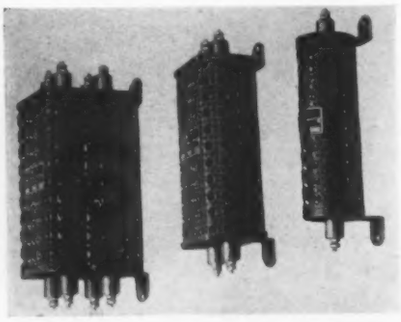
"Hi-Lite" strain clamp, accommodates 0.35 to 0.55-in. conductors when unlined, 0.30 to 0.45-in. conductors with liners. **Ohio Brass Co.**, Mansfield, Ohio.

possible to attach the "blocks" for securing proper conductor tension directly in the clamp. When the tail block is hooked in the new loop and the conductor is brought to tension the entire dead-end assembly assumes a position that is practically a continuation of the conductor. In addition, the loop is said to permit more accurate sagging and make hot-line work easier and safer.

•

Cage Type Resistors

New standardized series of ventilated cage type resistors is announced for one, two or four resistors. Suggested for use where it is desired to prevent accidental contact with the resistor, these resistors are often mounted on switchboards and test panels in control, protective or line voltage dropping circuits, where up to several hundred watts are to be dissipated.



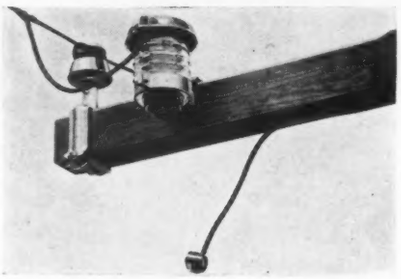
Ventilated cage type resistors; over-all dimensions, 4¼, 2 29/32 and 2⅜ in., respectively, by 9 9/16 in. long. **Ohmite Mfg. Co.**, Chicago, Ill.

Terminals of resistors are brought out at end by "feed-through" type porcelain insulators, making interconnection simple.

•

Lightning Arrester

Termed an "Isolator," this new development has been designed to eliminate outages caused by grounding of circuit through damaged lightning arresters. An upper electrode is electrically connected to the valve material, a lower electrode to the ground lead; a pocket inside the upper electrode contains a combustible powder. Should the arrester be damaged, permitting continued flow of follow current, the powder in the Isolator disconnects the ground lead. The dropped ground lead thus gives the lineman indication of a necessary arrester replacement.



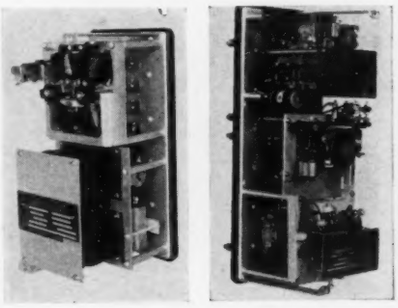
"L-M." lightning arrester, with new indicating Isolator; top, normal position; bottom, disconnected position. **Line Material Co.**, South Milwaukee, Wis.

Future Modernization . . .

In the editorial pages of this issue you have seen and read about typical examples of prudent modernization work of electric utilities in the economic rehabilitation of their power systems. In the New Equipment section of each issue, ELECTRICAL WORLD pictures and describes the equipment which will be used by utilities *and* industrial plants in their *future* modernization programs

Relay Developments

New relay developments of this company include: (1) Type HFA auxiliary, self-reset relay; (2) type HDC harmonic-



Type HFA not shown; Type HDC, left; Type GDL, right; each without cover. **General Electric Co.**, Schenectady, N.Y.

restraint current relay for use in bus differential protection; (3) type GDL out-of-step relay. A claimed advantage of the auxiliary relay is that its stationary single-throw contacts are easily reversible in the field. An operating element and a restraining element give the harmonic-restraint current relay a construction identical to that of the fault detector of carrier-current protective apparatus. Operating circuit is tuned to pass fundamental line frequency and restraining circuit is tuned to block this frequency. The out-of-step relay has been developed for application to motors or generators where the electrical center of the system is sure to be inside the machine. An instantaneous plunger type overcurrent relay and a fast watt-metric relay are combined to detect current increases and power reversals as the machine gets out of step.

•

Line Construction Truck

New model truck for line construction work includes such equipment as pole derrick complete with skid rail, pair of jacks and anchor, universal sheave block with socket, mushroom head and hook, pintle hook and "A" frame mounting,

Model "EH" Mack Truck; used by Long Island Lighting Co. **Mack-International Motor Truck Corp.**, Long Island City, N. Y.

There is this about C-B equipment. You don't have to wait years to find out if you have made a good investment, because—

FIRST . . . . . The most casual inspection reveals superiorities in design, construction and advanced engineering practice.

SECOND . . . Quality and workmanship are immediately apparent.

THIRD . . . . A complete understanding of utility requirements is evidenced in the size, placement and accessibility of all units.

FOURTH . . . They prove their time-, labor- and money-saving abilities from the moment of installation.

FIFTH . . . . . They bear the famous C-B trade-mark—an identification that means tops in service entrance equipment.

More important, however, is the unfailing day in and day out performance of C-B equipment in thousands of installations, and the hearty endorsements of scores of utilities. When you use C-B Service Entrance Equipment, designed to meet the needs of modern distribution systems, you enjoy many continuing profitable advantages, freedom from current diversion and sharply reduced installation costs.

The Corcoran-Brown Technical Staff is available without cost or obligation to assist in the application of C-B Service Entrance Equipment to present or contemplated installations. Details on request.

The widely used C-B 14 meter enclosure, made for outdoor and indoor new sequence metering. Complete details and specifications of all C-B equipment will be found in Bulletins 57, 58A, 60, 61 and 62. Write for copies.

Electrical Department

CORCORAN-BROWN LAMP DIVISION

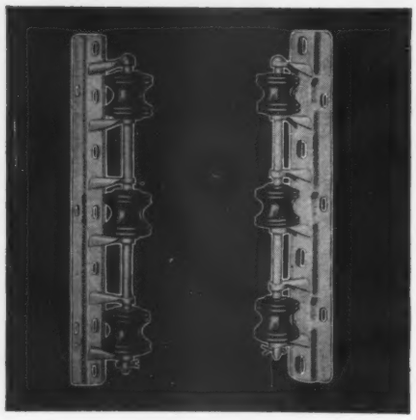
THE ELECTRIC AUTO-LITE COMPANY

4900 Spring Grove Avenue Cincinnati, Ohio

OLIVER

Pole Line Material

PERFECTED PRODUCTS OF OVER FORTY YEARS OF ENGINEERING AND RESEARCH



APACE WITH EVERY NEW POLE LINE MATERIAL REQUIREMENT

Pioneering in the design and manufacture of Pole Line Materials since 1894, Oliver engineers are still pioneering—still constantly improving their products to meet the ever increasing demands of modern electrical power transmission and distribution systems. Get the benefit of these improvements by specifying Oliver for *your* pole line requirements.

OLIVER IRON AND STEEL CORPORATION

PITTSBURGH · PENNSYLVANIA

OLIVER POLE LINE MATERIALS

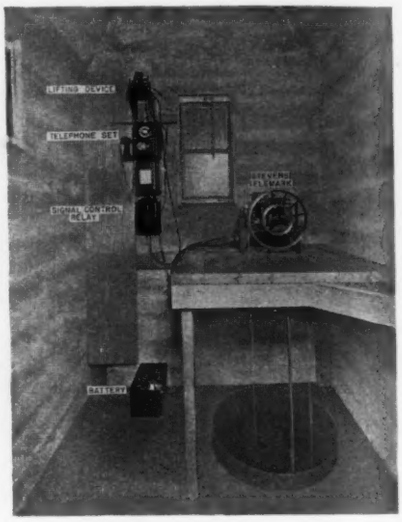
APPROVED AND ACCEPTED SINCE 1894

and tow hooks at the front of the vehicle. Another feature is the "Mead-Morrison" clutch winch, complete with cab control, reverse power take-off and two speeds, which can pull 15,000 lb. in low speed on the first layer of rope, it is claimed.

•

Position-Signaling Device

Called the "Telemark," this device will signal over telephone circuits the position of a moving element such as a gate or valve, gage height of a river, or elevation of water in a reservoir or tank. Say it is used in a gage house to measure river height, as shown. Ringing the telephone in the gage house actuates a signal control



Stevens "Telemark." **Leupold, Volpel & Co.**, Portland, Ore.

relay which closes a battery circuit in which is a locking relay on the Telemark. This relay closes another circuit in which there are two motors. One motor lifts the telephone receiver, while the other starts a contact arm revolving over ridged disks positioned by a float on the river. Simultaneously, an oscillating vacuum tube is energized to produce a musical tone whenever the contact arm rides over a ridge on the disks. Position of moving body is determined from the signals heard over the telephone.

•

Fuse Switch

"Trip-O-Link" fuse switches; 5,000 volts through 15,000 volts; 50 amp. **James R. Kearney Corp.**, St. Louis, Mo.

Capacity of these fuse switches has been increased 100 per cent. Instead of a fuse cartridge, each fuse link incorporates a fuse tube, so with each re-fusing a new cartridge is supplied.

•

Pipe and Stud Extractors

"Reps" extractors; set of 10 fits pipe from ⅛ to 2 in., studs, screws and bolts from 7/16 to 3½ in. **Reps Tool Co., Inc.**, Buffalo, N. Y.

Utility repair and maintenance departments should find interesting these newly developed extractors for extracting broken pipe and studs. Tools have a four-point grip to prevent reaming and provide a strong "bite" without hammering or pounding. Broken pieces of pipe are removed by inserting the extractor into the pipe so all four points grip at the same time and then by turning the extractor with a wrench in the direction of the device's

threads. Made of cadmium-plated, heat-treated forged steel, with a Brinell hardness of 490.

•

Constant-Current Regulators

For maintaining a constant current on a series lighting circuit under all types of loading, new pole-type and subway-type constant-current regulators have been announced. Regulators are said to be

Type "CP," pole-type; type CM, subway type, not shown; sizes from 2 to 30 kw., with primary voltages of 2,400 or 4,800 volts, secondary current ratings of 6.6 or 20 amp. **Westinghouse Electric & Mfg. Co.**, East Pittsburgh.

designed not only to fulfill normal operating requirements but also to meet impulse voltage conditions. They are designed to have same basic insulation level and bushing characteristics as are standard for distribution transformers.

•

New Solders

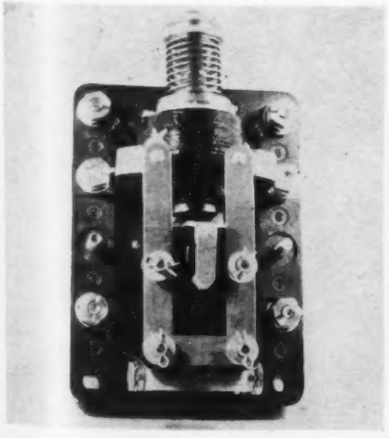
"Hi-Tensile" line of solders. **National Cable & Metal Co.**, Glendale, Calif.

Increased tensile strength and lowered melting point are claimed for this new line of solders. In addition, they are said to have increased electrical conductivity, to bond more easily with work being soldered and to be noticeably cleaner.

•

Overload Relay

New overload relay is offered for operation on a.c. or d.c. Contacts can be



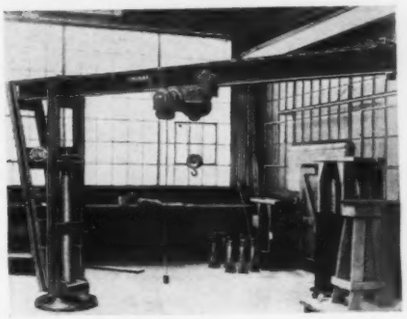
Overload relay; rated 30 amp. at 110 volts, a.c., 20 amp. at 220 volts a.c., 6 amp. at 110 volts d.c. and 3 amp. at 230 volts d.c., on non-inductive loads. **Struthers Dunn, Inc.**, Philadelphia, Pa.

arranged to be closed manually or by means of a voltage-operated coil; when closed, they latch closed. Latch is adjusted to pick up and open contacts when current on overload coil reaches proper value. This setting is adjustable, by means of the knurled nut on the top of the relay, over a range of 2 to 1.

•

Pillar Jib Crane

New self-supporting pillar jib crane is offered for work in side bays, low headroom areas and other confined spaces where overhead traveling crane or hoist service is not available or practical. Crane is built in capacities up to 5 tons, heights to 20 ft. and to a maximum radius of 20 ft. It may be furnished with the company's pendant rope or push-button controls on the hoist, or may be equipped, at extra cost, with the newly developed push-button master variable-speed controller which controls lifting, lowering and traveling operations.



"P&H" pillar jib crane; operates on 220-440-550 volts, two- and three-phase, 25 and 60 cycles, or on 115-230 volts d.c. **Harnischfeger Corp.**, Milwaukee, Wisconsin.

•

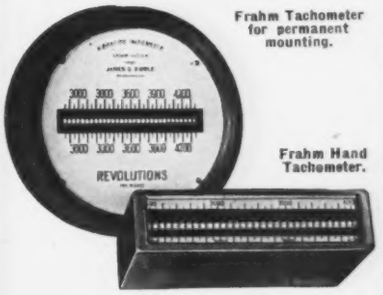
Pole-Pulling Jack

New pole-pulling jack has a hinged-type base which permits operation at different angles. Control for the auto-

No. 3815-H pole-pulling jack; load capacity, 15 tons; 38 in. high, has a rise of 24 in. **The Buda Co.**, Harvey, Ill.

matic lowering device is located at the top of the jack, in full view of the operator. Safety stop prevents the rack bar from running out of the frame and causing accidents. Jack alone weighs 88 lb.; weight of complete equipment, 177 lb.

INSTRUMENTS *for* MEASURING SPEED



Frahm Tachometer for permanent mounting.

Frahm Hand Tachometer.

"FRAHM" TACHOMETERS

measure r.p.m. as well as rates of vibration, merely by being mounted on or held against the machine under test: they require no belts, gears or electrical connections. Speeds up to 30,000 r.p.m. or v.p.m. Widely used on steam turbines and centrifugal pumps. Hold original calibration during years of continuous service. Write for descriptive Bulletin *1510-W*.

"Jagabi" Speed Indicator

(Chronometric Type)

measures average r.p.m. or feet per minute without any calculations. Simply insert tip and press button. Automatic, accurate and reliable. Reads up to 20,000 r.p.m. and 10,000 feet per minute. Described in Bulletin *1505-W*.

"Jagabi" Hand Tachometers

(Centrifugal Type)

measure rotating speeds directly in r.p.m. and linear and peripheral speeds in feet per minute. Also show speed variations. Accurate, dead beat and dependable. Ranges up to 40,000 r.p.m.

Write for Bulletin *1505-W* which describes these as well as other types of speed-measuring instruments.

JAMES G. BIDDLE CO.

ELECTRICAL INSTRUMENTS

1211-13 ARCH STREET PHILADELPHIA, PA.

ADEQUATE WIRING SERVES AND SAVES

From
FOUNDATION
to
FLAGPOLE

...*But* WIRE IS ONLY AS GOOD AS ITS INSULATION

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United States Rubber Company

United States Rubber Products, Inc., 1790 Broadway, New York, N. Y.

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MANUFACTURERS OF ELECTRICAL WIRES AND CABLES

LINEMEN'S BLANKETS · SPLICING COMPOUND · TAPE · SWITCHBOARD MATTING

News ABOUT PEOPLE

H. H. Fisher and L. P. Works Given New Executive Duties

Several important changes in the executive staff of the Menominee and Marinette Light & Traction Company, Milwaukee, Wis., have been announced by A. J. Goedjen, vice-president. H. H. Fisher, Wausau, has been appointed manager of the company and John A. Sargent, Green Bay, has been made assistant manager. L. P. Works, formerly manager of the Menominee and Marinette company, has been named electric distribution practices engineer for both the Menominee and Marinette Light & Traction Company and the Wisconsin Public Service Corporation.

Mr. Fisher has had a varied experience in the utility field. For more than 35 years he has been engaged in public utility engineering and construction work and for the past four years has been associated with the Public Service Company at Wausau. His

H. H. Fisher

work in Wisconsin included the construction of the large Bayside steam generating station at Green Bay, erection of the modern gas plant at Sheboygan, as well as the construction of many of the important transmission lines in Wisconsin. He also constructed power plants in other sections of the United States, including the

L. P. Works

$9,000,000 hydro-electric plant at Passerville, Calif., and the $5,000,000 steam plant at Louisville, Ky.

During his association with the Wisconsin Public Service Corporation, Mr. Sargent has had a varied training in the utility business. Since 1929 he has been a manager of one of the electric departments in the Green Bay area.

Mr. Works first became associated with Wisconsin Public Service Company in 1920 when he was first employed as an engineer on the construction of the Green Bay-Sturgeon Bay transmission line. Subsequently he was transferred to the engineering department and later was appointed superintendent of electric distribution in Green Bay. In October, 1928, he was appointed manager of the Menominee and Marinette Light & Traction Company.

•

▶ WAYNE J. HOLMAN, JR., assistant district manager, Newburgh district, Central Hudson Gas & Electric Corporation, Poughkeepsie, was declared a winner in a national competition for the Alfred P. Sloan Foundation fellowships for a year's graduate study in Business Administration and Economics at the Massachusetts Institute of Technology.

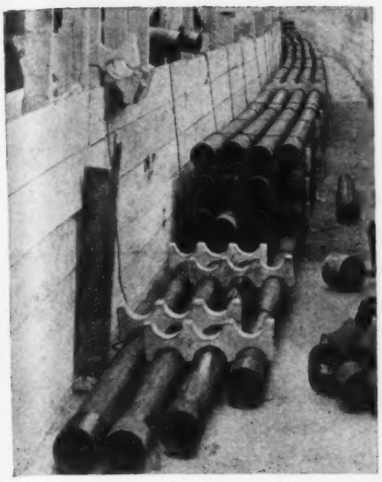
L. F. Adams Manager of New G.-E. Standards Department

Lee F. Adams, who was named manager of the newly formed standards department of the General Electric Company, was formerly connected with the company's commercial general department. Mr. Adams first became associated with G.-E. in 1906 and after a year he joined the teaching staff of his alma mater, Pennsylvania State College, returning to General Electric in 1909 as a member of the induction motor engineering department. Subsequent assignments were to the industrial engineering department and the commercial general department.

He has been a member of the U. S. national committee of the International Electrotechnical Commission. As company representative in the National Electrical Manufacturers Association, Mr. Adams has been chairman of the codes and standards committee and he

L. F. Adams

represented the N.E.M.A. on the standards council of the American Standards Association. He is also a member of the American Institute of Electrical Engineers. In 1930 he was the recipient of the James H. McGraw award to electrical manufacturers in recognition of his outstanding leadership in the coordination and advancement of the



THE EXACTING DEMANDS OF *Prudent Modernization*

are met by the ultimate economy of the complete cable protection of *STANDARD ORANGEBURG FIBRE CONDUIT* installed with concrete encasement.

Today, as for 45 years, Standard Orangeburg is insurpassed for main distribution, duct bank, high tension and "downtown" underground construction.

AND *Now* ORANGEBURG NOCRETE

THE NEW *Dual economy* CONDUIT

FOR USE WITHOUT CONCRETE ENCASEMENT

● also offers substantial savings in both initial material and installation costs for use wherever conditions suggest installations of conduit *without* concrete encasement. ....It is about half the cost of metal pipe and less than non-metallic conduits of any comparable quality. Substantial savings in installation costs of this new super-sturdy duct result from easier handling; easier cutting and tooling; adaptability to going around curves and obstructions; quick field assembly.

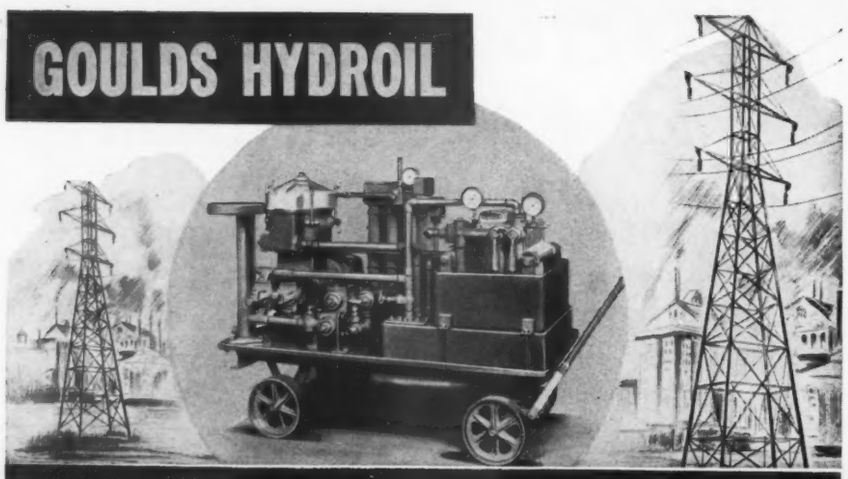
For service entrances, extensions, parkway and street lighting, suburban services, laterals, etc., specify Orangeburg NOCRETE and get not only immediate savings but future savings from decades of maintainance-free service.

THE FIBRE CONDUIT COMPANY, 292 MADISON AVE., N. Y. C.

Sales Agent-Distributors
GENERAL ELECTRIC SUPPLY CORP.
GRAYBAR ELECTRIC COMPANY, INC.

THE FIBRE CONDUIT COMPANY · ORANGEBURG · Since 1893 · ORANGEBURG, N.Y.

ORANGEBURG



KEEP INSULATING OILS CLEAN AT LOW COST

One of the best safeguards against shutdowns of transformers, oil switches and circuit breakers is clean dry insulating oil.

Goulds Hydroil Insulating Oil Purifiers remove sludge, moisture, carbon, and other impurities from insulating oils at low cost.

The outstanding performance of this centrifugal oil purifier and its portability, reduce the hazards of short circuits and the dangers of costly interruptions.

In every instance, leading power companies have found Goulds Hydroil Insulating Oil Purifiers contribute to greater operating efficiency and keep their customers satisfied.

Goulds Engineering Service is yours to draw on. Write today for complete information. Ask for Bulletin No. 503.

GOULDS PUMPS Inc.
SENECA FALLS N.Y.
ATLANTA, BOSTON, CHICAGO, HOUSTON, NEW YORK, PHILADELPHIA, PITTSBURGH, TULSA, Representatives in all Principal Cities

8337

standardization and simplification of electrical products.

In addition to the responsibility of coordinating all activities pertaining to the development and application of standards throughout the company, Mr. Adams will also act as assistant to Vice-President E. O. Shreve.

•

C. E. Hart Elected Head of Chase Brass & Copper

At a recent meeting of the executive committee Charles E. Hart was elected executive vice-president of the Chase Brass & Copper Company, Inc., Waterbury, Conn. He succeeds F. S. Chase

as active head of the organization. Mr. Chase retains his title as company president.

A native of New Britain, Conn., and a graduate of Yale University, Mr. Hart served as corporation counsel for the City of Waterbury for about two and a half years before he became identified with the Chase Companies, Inc., in 1924 as general counsel. Mr. Hart was advanced to secretary of the company several years ago, and last year was named vice-president in addition to secretary.

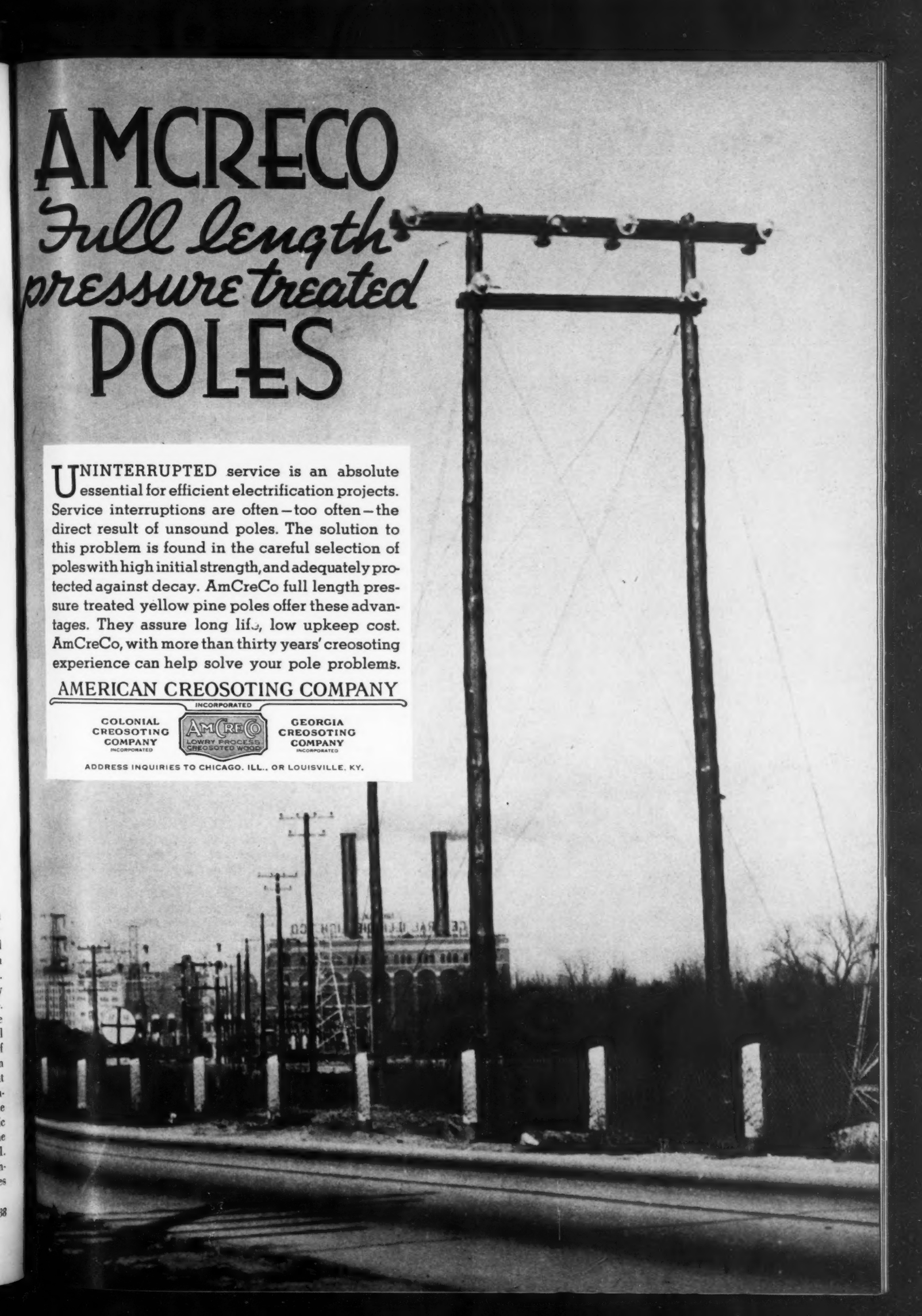
•

▶ E. N. Horsey, resident engineer with the British Columbia Electric Railway Company at Victoria, has been appointed manager of the light and power division of the company on Vancouver Island. Mr. Horsey fills the vacancy caused by the recent death of S. J. Halls. E. G. Hart, who has been a member of the engineering staff at Victoria for several years past, will assume the position of resident engineer under the supervision of G. M. Tripp, general superintendent of the company's activities on Vancouver Island. Mr. Horsey joined the staff of the British Columbia Electric Railway Company at Victoria in the capacity of assistant engineer in 1911. He assumed the duties of resident engineer in 1913, and in 1918 his duties

AMCRECO

Full length pressure treated

POLES



UNINTERRUPTED service is an absolute essential for efficient electrification projects. Service interruptions are often—too often—the direct result of unsound poles. The solution to this problem is found in the careful selection of poles with high initial strength, and adequately protected against decay. AmCreCo full length pressure treated yellow pine poles offer these advantages. They assure long life, low upkeep cost. AmCreCo, with more than thirty years' creosoting experience can help solve your pole problems.

AMERICAN CREOSOTING COMPANY

INCORPORATED

COLONIAL CREOSOTING COMPANY INCORPORATED

AMCRECO LOWRY PROCESS CREOSOTED WOOD

GEORGIA CREOSOTING COMPANY INCORPORATED

ADDRESS INQUIRIES TO CHICAGO, ILL., OR LOUISVILLE, KY.

Do you ever stop to think how rarely, if ever, your telephone fails? Good telephone service is the result of an unusual combination of operating skill and dependable equipment. Our part is the equipment.

PRESIDENT

Built for Service

MOST people take their telephone pretty much for granted.

Though rugged in construction, it contains no less than 248 separate parts which must fit together and function with such mechanical and electrical precision that you can talk over it—through the nationwide network of wires and cables and switchboards of the Bell System—anytime, anywhere.

One reason why this is possible is because the Western Electric Company, the manufacturing unit of the Bell System, makes telephone equipment in which service is the first consideration—since this equipment is built for long life and low maintenance cost. The telephone companies acquire this apparatus at favorable prices made possible by the economies of large scale production and Western Electric's policy of moderate profits.

The savings which your telephone company thus makes on its equipment help to offset increases in taxes, wages, and other elements in the cost of providing an increasingly complex service.

Thus Western Electric contributes its part in making Bell Telephone service dependable and economical.

Western Electric

BELL SYSTEM SERVICE

IS BASED ON

WESTERN ELECTRIC QUALITY

were broadened to include hydro-generating plant, transmission lines, and engineering embracing the company's holdings on Vancouver Island.

•

N. Y. Electrical Society Elects Executive Officers

Charles W. Horn, director of research and development for the National Broadcasting Company, was elected president of the New York Electrical Society at its recent annual meeting. Mr. Horn, who has served as first vice-president of the organization for the past year, succeeds Arthur H. Kehoe, vice-president Consolidated Edison Company of New York.

Other officers elected by the society were R. W. King, assistant to Dr. Frank B. Jewett, president of the Bell Telephone Laboratories, first vice-president; G. Failla, physicist at Memorial Hospital, second vice-president and George F. Fowler, a member of the technical staff of the Bell Telephone Laboratories, treasurer. Colin G. Fink, professor of electro-chemistry at Columbia University, and H. L. Ward, assistant engineer of plant of the Western Electric Company, were made members of the board of directors to serve three-year terms.

•

Named to West Penn Board

Announcement has been made of the election of Allen N. Cartwright, vice-president; Philip H. Powers, vice-president, and Wilford H. Swinney, controller, to the board of directors of West Penn Power Company.

•

▶ B. B. MARSH, district manager for the Alamaba Power Company at Montgomery, Ala., has been elected second vice-president of the Montgomery Safety Council.

▶ WENDELL L. WILLKIE, president of the Commonwealth & Southern Corporation, was recently made the recipient of the honorary degree of Doctor of Laws by Indiana University, his Alma Mater.

▶ GEORGE BARKER, vice-president in charge of real estate and purchases of the Public Service Corporation of New Jersey, and John L. O'Toole, vice-president in charge of public relations, have been elected members of the board of directors of that corporation. They are succeeding John E. Zimmermann, president of the United Gas Improvement Company and Edward Hopkinson, Jr. of Philadelphia, a director and member of the executive committee of the Philadelphia Electric Company, who have resigned from the

They Cut Down Outage Costs...

THAT'S WHY THE TREND IS TO L-M RECLOSING FUSE CUTOUTS

L-M Type "RLD"
Open Type
Re-Closing Cutout
5000, 7500/12500, 15000 Volts
50 and 100 Amperes

L-M Type "RLO"
Open Type
Re-Closing Cutout
5000, 7500/12500, 15000 Volts
50 and 100 Amperes

L-M Type "RP"
Porcelain Housed
Re-Closing Cutout
5000 V, 50 Amperes

Bigger loads mean *bigger losses* when outages occur. More meters stop turning, more customers are inconvenienced. That is why operating men are sectionalizing today's busy lines with L-M Reclosing Fuse Cutouts. L-M Reclosing Cutouts pay for themselves preventing needless outages. On many feeder and customer substations, too, L-M Reclosing Cutouts provide protection at much lower cost than other automatic reclosing circuit-interrupting equipment.

Get These L-M Features

Fully Automatic Operation. The dropping action of the cartridge when the fuse link blows automatically transfers the circuit to the next adjacent fuse. Replacing the blown fuse link and returning the re-fused cartridge to its "up" position automatically restores the cutout to full operating sequence. There is nothing to "cock" . . . nothing the lineman must remember to do.

Bellows Time Delay. An ingenious trouble saver . . . this L-M Device insures a time lapse between opening and reclosing the circuit, allowing time to clear the fault, preventing needless blowing of the second fuse.

Firm, Sure Contacts. L-M Fuse cartridges are positively latched in normal position. They cannot drop out of contact due to vibration. They are "up" till the fuse link blows.

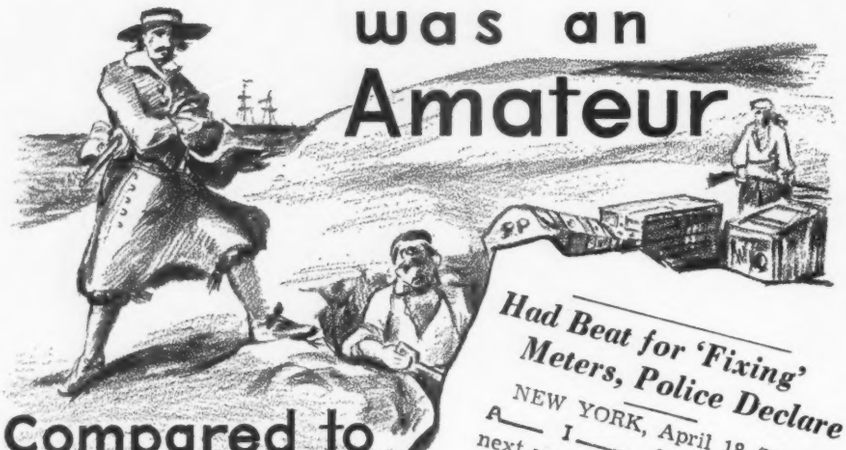
Plain Indication. L-M Reclosing Cutouts have only two positions . . . . "up" position and dropout position. One glance tells where re-fusing is needed . . . . no confusing third or intermediate position.

Ask Your L-M Representative For Full Details.

LM

LINE MATERIAL CO.

Captain Kidd was an Amateur



Compared to the modern

METER PIRATE

Had Beat for 'Fixing' Meters, Police Declare

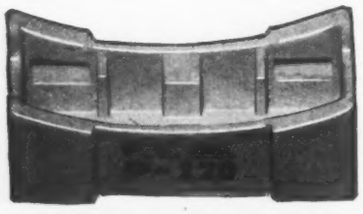
NEW YORK, April 18 (INS).—A I——, 2—, faces court next week on a charge of "fixing" gas and electric meters for the past 20 years so that they failed to register. Police charge I—— had a regular beat with regular customers and made as high as $300 a month by putting "jumpers" on the meters. They charged he collected one-third of what he saved his customers.

Reprinted from Trenton, N. J., Times Apr. 18, 1938

You can "fix" meters too . . . . . fix them with

STAR METER SEAL

for your profit—or let others "fix" them with jumpers at your loss. The one effective and permanent solution to the problem of current diversion is the equipment of all CS type meters with STAR METER SEAL. It is a porcelain cap that prevents tampering and must be destroyed or mutilated, beyond further use, to be removed. Millions of them are in use today saving hundreds of thousands of dollars annually at infinitesimal cost.



SEND FOR SAMPLE AND PRICES

Address Meter Seal Dept.

The STAR PORCELAIN COMPANY
TRENTON NEW JERSEY

MAKERS OF ELECTRICAL PORCELAIN SINCE 1899

board due to complications existing as a result of new Federal legislation affecting utilities. Mr. Barker has been with the corporation since 1903 and has been a vice-president thirteen years. Mr. O'Toole has been connected with Public Service since 1909 and has been a vice-president since 1923.

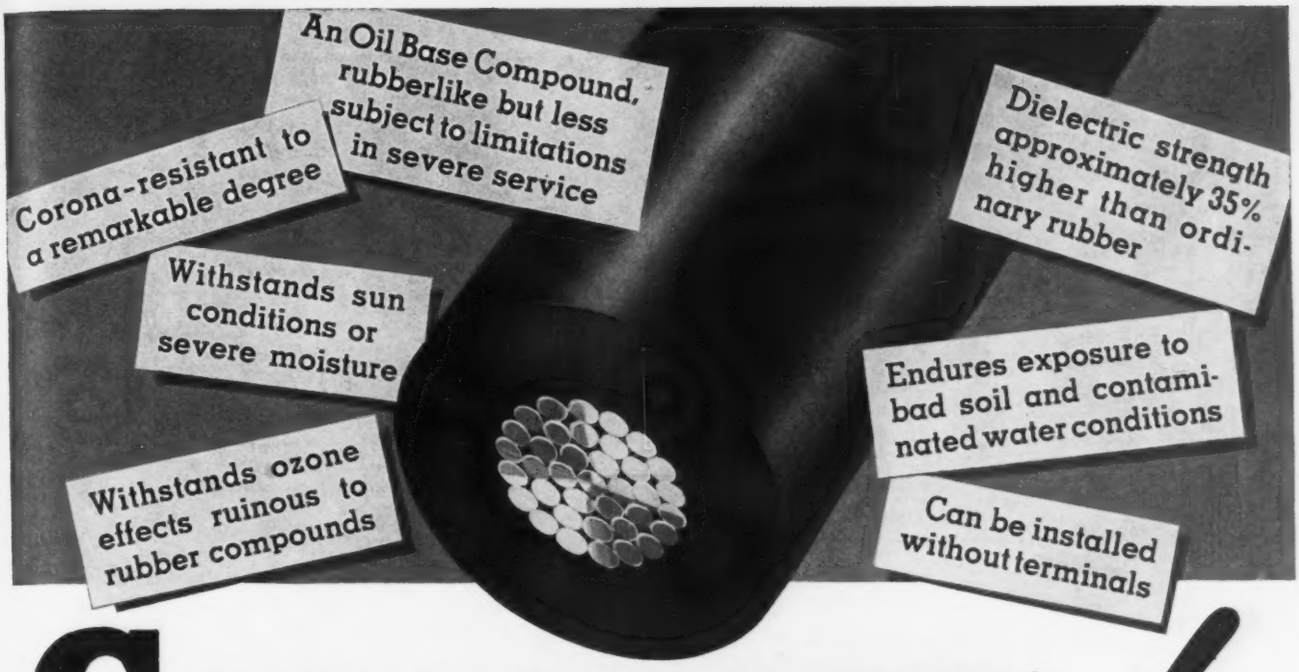
▶ E. K. LEARY, until recently district superintendent of the Alabama Power Company at Sheffield, is now Decatur district superintendent. Mr. Leary has been with Alabama Power Company since 1920, serving in various capacities in Anniston and Montgomery.

OBITUARY

▶ DONALD M. WHITESELL, utility engineer for the Michigan Municipal League, died April 30, after a brief illness, in his thirty-ninth year. Mr. Whitesell was also secretary-treasurer of the Michigan Municipal Utilities Association and had served as consultant in the construction and management of several municipal electric and gas plants in Michigan.

▶ DR. SAMUEL S. EDMANDS, director of the School of Science and Technology at Pratt Institute, Brooklyn, N. Y., died May 24 as the result of injuries received in an automobile accident. A graduate of the Worcester Polytechnic Institute in electrical engineering, Dr. Edmands worked for the American Telephone & Telegraph Company in Providence, R. I., and was associated with the teaching staff of Ohio State University before joining the faculty of Pratt Institute in 1901. He was 61 years of age.

▶ WILLIAM E. HIGHFIELD, one of Britain's outstanding electrical engineers, died recently at Cookham Dean, a few miles out of London. Mr. Highfield was a partner in the consulting engineering firm of Highfield and Roger Smith. Mr. Highfield joined his brother, J. S. Highfield, in consulting work in 1921, bringing to the re-equipping of generating stations in Britain, France and Belgium the knowledge of the skilled designer. Later Roger Smith joined the organization, which was appointed by the Central Electricity Board as one of the three consulting engineers intrusted with carrying out the construction of the national Grid network. An authority on technical education, Mr. Highfield had much to do with the success of the National Certificate in electrical engineering. His work on many committees as a vice-president of the Institution of Electrical Engineers was recognized as of outstanding value.


An Oil Base Compound, rubberlike but less subject to limitations in severe service
Corona-resistant to a remarkable degree
Withstands sun conditions or severe moisture
Withstands ozone effects ruinous to rubber compounds
Dielectric strength approximately 35% higher than ordinary rubber
Endures exposure to bad soil and contaminated water conditions
Can be installed without terminals

Gencorone* INSULATION

of Advanced Performance

HISTORY

General Cable research on rubber and rubber-like high voltage insulation extends with unbroken continuity back into the distant past. A half century ago General Cable was working in anticipation of the day when 5000 volt transmission would startle the country; 38 years ago General Cable was first to produce a 25,000 volt rubber insulated cable. Modern advance in chemistry and standardized manufacture led to the development of Gencorone—with a many-times-multiplied factor of safety for high voltage use.

Gencorone insulation is distinguished from ordinary rubber compounds by its high dielectric strength, resistance to corona, and its long life without lead sheath. Because of these characteristics it is particularly adapted to high voltage and severe service installations in non-leaded constructions.

The operating record of millions of feet of Gencorone insulation up to 26,000 volts, over the past decade, together with accelerated aging tests for all possible conditions, have shown a performance heretofore unobtainable with rubber insulation.

Gencorone is supplied wholly on the basis of Performance Specifications. Where overall economy is measured by continuity of service and long life under the above-noted conditions, Gencorone commands preference. Our engineers will welcome an opportunity to discuss your particular requirements.

*TRADE-MARK

AVAILABLE IN BRAIDED, LEADED, PARKWAY AND CERTAIN NON-METALLIC CONSTRUCTIONS

Electrify WITH COPPER

GENERAL CABLE

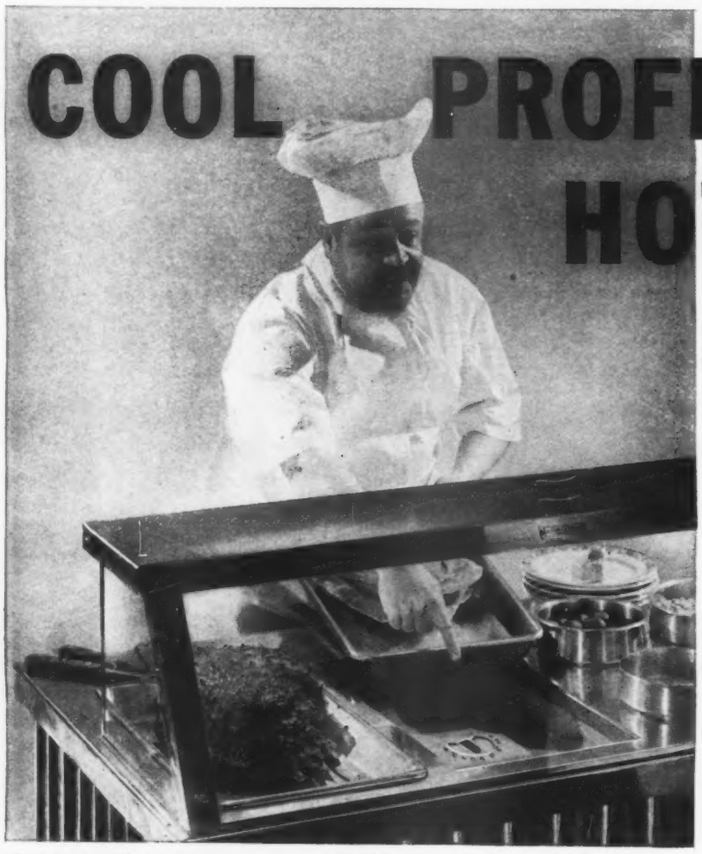
GENERAL CABLE CORPORATION

Sales Offices: ATLANTA • BOSTON • BUFFALO • CHICAGO • CLEVELAND • DALLAS • DETROIT • LOS ANGELES
NEW YORK • PHILADELPHIA • PITTSBURGH • ROME (N.Y.) • ST. LOUIS • SAN FRANCISCO • SEATTLE • WASHINGTON (D.C.)

TRADE TIPS FOR SALESMEN

HINTS AND HELPS FOR MEN ON THE BUSINESS FRONT

COOL PROFITS FROM HOT STORAGE!



EDISON STEAMLESS FOOD PANS ARE BIG SUMMER MONEY-MAKER

CUT WASTED HEAT IN HALF, SHARPLY CUT AIR-CONDITIONING COSTS

The Secret! *Set temperature exactly where you want it. Edison steamless storage keeps every food hot and delicious.*

Short Orders Are Our Meat—*Edison's new Heat Manager Griddle builds profitable short order business at low cost—pays for itself in savings alone.*

A summer sales "natural" if there ever was one! With Edison Hot Pans, food operators lower expenses and increase sales at the same time.

Summer air conditioning costs are reduced because Edison pans do not send excessive heat into the shop. Tests show that water and steam units have a heat loss 2 to 10 times greater than that of Edison steamless pans.

Heat spreads in all directions, must be removed by the air conditioning system, and—here is a startling fact!—*it costs at least* FOUR TIMES *as much to remove a heat unit by air conditioning as it costs to produce it.* Less heat waste, less air conditioning expense.

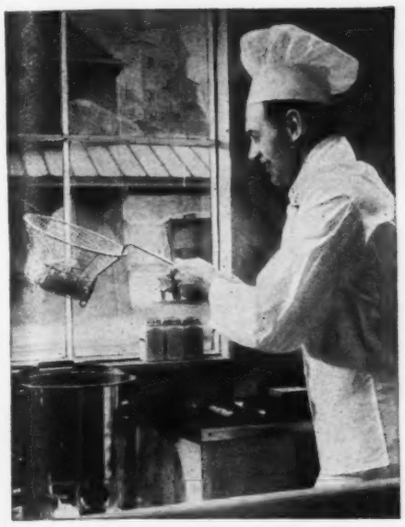
Less heat diffusion means greater customer comfort, greater customer contentment.

You can build a compelling selling talk on that one feature alone!

But food storage the Edison way also builds sales. Edison provides *individual* temperature control for each food. Every dish possesses just-off-the-range goodness. Proper temperature to keep a cream sauce from cooking out, proper heat to keep a stock soup hot and delicious.

Compare this with the old steam table method in which all utensils were kept in the same water bath. Temperature too high for one food, too low for another. Guests dissatisfied, eat elsewhere, complain that food is cold and has lost flavor. The shop loses all around.

TRADE TIPS · FOR SALESMEN



Money-Maker—*Here's the biggest money-maker in the food service field—Edison's famous Counter Fry Kettle. Portable—use it any place. Fries foods better—faster.*

Get behind Edison Steamless Hot Pans and increase your summer business. These modern units come in convenient sizes, are easily installed in old tables. No need for plumbing or drain connections.

A SALES ENGINEER AS NEAR AS YOUR PHONE

More and more equipment dealers are finding it wise to consult their local utility on electrical cooking sales. The utility has trained engineers thoroughly familiar with Edison products. They can usually answer questions even before a prospect brings them up.

Utilities are glad to give every possible selling aid because every Edison sale means increased commercial load. This is a very desirable type of electrical revenue.

We invite all dealers to call upon their electrical utility company for any type of assistance—not only in selling Edison products but also all other electrical products.

BRINGING DOLLARS THROUGH YOUR DOOR

It's become almost a slogan—that famous Edison phrase, "Hungry Eyes at Your Window Bring Dollars Through Your Door." We've stressed it in our advertising. We've told food operators large and small. To them it means window merchandising, stopping and selling sidewalk traffic.

All Edison products are ideal for this task. No smoke, no excess heat. Plug in and set a shining, streamlined Edison-Hotpoint appliance in a window. Then get to work and make 'em hungry.

Because most windows of eating places are usually waste space, an Edison action display makes an instant hit. Passersby like the show. The businessman likes the increased business. And increased business it does bring. Crowds have to eat somewhere. They eat where they *know* food is made tasty and tempting.

Whenever a food prospect tells you business isn't too brisk, you just tell him about Edison's sure-fire action show. "Hungry eyes" will bring dollars through his door and yours, too.

CLUBS ARE BUSINESS TRUMPS

When the sun peeps out and balmy breezes blow, thoughts turn to the great outdoors. Folks don't want to hibernate any longer. Out they go to their country clubs, and what a variety of clubs there are. Golf clubs, yacht clubs, tennis clubs, polo, beach, and hunt clubs!

So what? So these clubs are constantly modernizing old equipment. They have a select clientele and have to prepare food to satisfy that clientele. Enter the answer to their problem: Edison equipment.

The Heat Manager Griddle, for instance, makes "19th hole" short orders really short. No waiting for steaks, chops, hamburgers. No waste of food or fuel. Automatic controls eliminate uncertain results. Edison Griddle can be placed on a counter or narrow back bar.

It's a real sales winner. Sold at a new low price. Feature it. Country clubs are preparing for summer business NOW.

"THOUGHTS WHILE STROLLING"

The next time you don't feel like working—say, after lunch, take a leisurely walk down your main street and count the prospects for the popular Edison Counter Fry Kettle.

TAVERNS use it for potato chips and fish. CANDY STORES and NUT HOUSES let it increase business with fresh fried nuts. RESTAURANTS and DRUG STORES go to town with oysters, fish, chicken, and French fried potatoes. LUNCH ROOMS soar sales with kettle fresh doughnuts. Almost any eating house can use it an action display.

Every place where cooking is done is a prospect. Edison's Counter Fry Kettle is the largest money maker in the food service field and the market has scarcely been scratched!

For any additional information about any product mentioned, or about any product in the Edison-Hotpoint line, please write Grant Call, Manager Heavy Duty Division, Edison General Electric Appliance Co., 5618 West Taylor Street, Chicago, Illinois.

Every place that cooks is a prospect for Edison Electric Equipment.

EDISON

ELECTRIC FRY KETTLES • "HUSKY" RANGES
HOT FOOD STORAGE PANS • GRIDDLES
BROILERS • ELECTRIC OVENS

Distributed in Canada by
CANADIAN GENERAL ELECTRIC CO., LTD., TORONTO

Manufacturing AND MARKETS

Lead Shipments for Cable Off in Quarter

Domestic shipments of lead to manufacturers for cable covering during the first quarter were 13,768 short tons, against 20,662 in the same period last year, a drop of 33 per cent, according to the American Bureau of Metal Statistics. Shipments for this purpose in March were 5,452 short tons, against 3,713 in February and 4,603 in January this year.

Use of lead in the production of lead-covered cable in 1937 was 90,042 short tons, against 61,400 in 1936, a gain of 47 per cent. While last year's consumption is the highest since 1932, it is still well below the huge consumption reported for 1929, when 220,000 short tons were used for this purpose. Telephone, public utility, marine and industrial cables are included in this reporting, which is slightly more than the monthly shipments reported.

•

General Electric Reduces Second Quarter Dividend

A dividend of 20 cents a share will be paid on July 25 to stockholders of record June 24, President Gerard Swope announced recently, following a regular meeting of the board of directors. This compares with 30 cents a share in the first quarter of 1938 and with 40 cents in the second quarter of 1937.

John P. Wilson, a member of the law firm of Wilson & McIlvaine in Chicago, was elected a director of the company.

•

New Orleans to Undertake Adequate Wiring Campaign

More than 100 attended the recent meeting at New Orleans sponsored by the Electrical Association to announce details of the comprehensive plan for tying in with the National Adequate Wiring Program. O. C. Small, secretary of the bureau's executive committee, made the principal address on the subject of the national activity. The New Orleans plan calls for the use of the window display poster, the sound-slide film, three direct mail folders, the Pictorial Primer, "Copper in the Home" booklet, architects' specification and lecture chart.

•

Earnings Reported by Manufacturers

Electrical manufacturing companies that recently issued earnings reports include the following:

WESTON ELECTRICAL INSTRUMENT—Including wholly owned domestic subsidiary, March quarter: Net profit, $57,028, equal, under the participating provisions of the shares, to 52 cents each on 27,376 shares of no-par $2 cumulative Class A stock and 27 cents each on 160,583 shares of no-par common stock. This compares with $104,020, or 77 cents a Class A share and 52 cents a common share, last year.

ROME CABLE—Year to March 31: Net profit after surtax $71,027, equal to 37 cents each on 189,250 shares of $5 par common stock.

MCGRAW ELECTRIC—Year ended March 31: Net profit, $839,044, equal to $1.77 each on 472,600 shares of $1 par capital stock, compared with revised net profit of $1,156,271, or $4.89 each, on 236,396 shares outstanding at close of year ended on March 31, 1937. Net sales, $5,679,482, against $5,894,469.

REVERE COPPER & BRASS—Including wholly owned subsidiaries, net loss after amortization and deduction of $498,114 loss sustained on metal contents of sales during the period, $879,659. This compares with net profit last year of $1,414,712 after crediting $198,931 to metal stock reserve account, equal, after preferred and Class A dividends, to $1.98 each on 513,260 common shares.

JOHNS-MANVILLE—Including subsidiaries, consolidated net loss of $239,475, after all charges and provision for depreciation and depletion. This contrasted with net earnings in the first quarter last year of $1,021,919. Sales in the first quarter amounted to $10,435,119, a decrease of 19.7 per cent, compared with $13,001,665 in the similar quarter last year.

•

Moves New England Offices

Allis-Chalmers Manufacturing Company's New England District office has been changed to 1160 Park Square Building, 31 St. James Avenue, Boston.

Westinghouse Plans New Pension System

Westinghouse Electric & Manufacturing Company, which operated an old age pension system between 1929 and 1935, plans to re-establish a new system to supplement present federal security plans. Westinghouse dropped its first old age plan when Congress provided federal old age assistance, with the idea that a new plan would be worked out to supplement the government plan when it became "stabilized."

"That the plan has not yet matured," Vice-President W. G. Marshall said, "is due only to uncertainty and the probability of change that surround present government enactments."

Under the Social Security Act, Westinghouse in 1937 paid to federal and state governments $4,041,482. Of this $1,055,333 was contributed by the employees and the balance by the company. The average payment of the workers was $20 and the company $57 per worker.

•

York Ice Gets Navy Order

York Ice Machinery Corporation, York, Pa., has received a contract from the United States Navy Department to furnish air-conditioning and refrigerating equipment for two submarines and a cruiser. Equipment will be installed in the navy yards at Brooklyn and Portsmouth.

•

Air Unit Installations Up

Air-conditioning installations in use or under contract in Chicago have passed the 2,000 mark, according to a report made recently by the Commonwealth Edison Company. Seventy-three air-conditioning installations were sold during the month, setting a new all-time high record for April and bringing the total number of plants in service or under contract to 2,058.

Sixty contracts were reported in April, 1937, and 39 in March of this

Expert *Inspection*

by full-time employed and specially trained Engineers, each licensed by the National Board of Boiler and Pressure Vessel Inspectors is

THE BEST *Power Plant* PROTECTION

If breakdowns or accidents could be certainly avoided in private industrial Power Plants, as well as those serving the communities of the nation, the annual national saving would be very large.

Experience has taught us that men and machinery are seldom unfailing, never-the-less the "Ocean" and "Columbia" Insurance Systems aim at nothing short of Accident Avoidance in plants of policyholders. We furthermore consider it our responsibility to detect and report conditions which impair operating efficiency or tend to shorten the useful life of your equipment.

You and we know that when avoidance of accidents is achieved it is due to the eternal vigilance of Inspection - - regular, competent, understanding and searching inspection. That is why the "Ocean" and "Columbia" Companies have developed their Engineering Inspection Service to such a standard of efficiency that we can proudly say of it "It is Your Best Protection".

Ask your own Insurance Advisor—he knows.

THE OCEAN ACCIDENT & GUARANTEE CORPORATION
COLUMBIA CASUALTY COMPANY

One Park Avenue, New York, N. Y.

Canadian Branch: **The Ocean Accident & Guarantee Corp., Ltd., Federal Building, Toronto, Ontario**
Cuban Correspondent: **Compania Cubana de Fianzas, Amargura 23, Havana, Cuba**

. . . PUTS ITSELF OUT

in a Blizzard of Snow

Even when no one is nearby, this extinguisher will detect fire . . . will snuff it out instantly. When fire breaks, it releases a flood of LUX carbon dioxide snow-and-gas . . . and promptly kills itself. Fire puts itself out!

An automatic LUX Fixed System uses the *fastest* known extinguishing agent . . . Lux carbon dioxide snow-and-gas. It is expanding at the rate of 450 times in volume when it floods the equipment. Lux snow drives into every remotest crevice . . . gets into tight-wound wiring . . . kills fire where it finds it.

Harmless—Time-Saving

Lux snow is *completely harmless* to costly electrical equipment. It limits damage to that done by the actual fire.

For central station use, one properly located battery of Lux cylinders will give complete protection . . . to generators, oil circuit breakers. The cost . . . usually under .005¢ per kilowatt of capacity. Can we give you actual figures on your own plant? Write for "Lux Makes The Difference."

Walter Kidde & Company

60 West Street, Bloomfield, N. J.

year. Capacity of installations sold last month was 817 hp., compared with 1,044 hp. in the corresponding month last year and with 596 hp. in March of this year.

•

Largest Air Unit System Afloat on Nieuw Amsterdam

The largest air-conditioning system afloat poured cool air into the Holland-American liner *Nieuw Amsterdam* on her maiden voyage across the Atlantic recently. A Carrier air-conditioning system supplies 300 tons of refrigeration a day.

The system was designed by Carrier Corporation of Syracuse, N. Y., which installed the air-conditioning systems on the *Queen Mary* and the *Normandie*. The *Nieuw Amsterdam* system is 75 tons larger than that of the *Queen Mary* and 114 tons larger than the *Normandie* equipment.

•

Forms New Sales Company

J. T. O'Hara, formerly with the Amthor Testing Instrument Company, has organized the J. T. O'Hara Sales Company, 620 East 43d Street, Brooklyn, N. Y. He plans to handle a complete line of tensile strength testing instruments, scales, dead-weight gage testers and similar products.

•

Export Licenses Renewed

Some eighteen licenses for the export of approximately 395,000 hp. of electricity to the United States from different points in Canada, which expired on March 31, have been renewed for another year by the Dominion Government. Renewal of the licenses by order-in-council was not approved until Premier King secured from Secretary Hull of the United States an assurance that the U. S. Administration had no objection to such step being taken by the Canadian Government.

•

Opens Radio Station

The new National Broadcasting Company building and Westinghouse Electric & Manufacturing Company radio station KYW in Philadelphia were opened last week.

New York Metal Prices

	May 25, 1938 Cents per Pound	May 31, 1938 Cents per Pound
Copper electrolytic	9.00*	9.00*
Lead Am. S. & R. price	4.25	4.00
Antimony	12.00	12.00
Nickel ingot	35.00	35.00
Zinc spot	4.40	4.40
Tin straits	37.25	36.75
Aluminum, 99 per cent.	20.00	20.00

* Delivered Connecticut Valley.

CONCENTRATION

WEBSTER defines *concentration* as a "simultaneous firing upon a common target, or bringing to a common center."

The entire resources of Cornell-Dubilier . . . its engineering experience, skill and ingenuity are concentrated on the building of dependable capacitors—and capacitors alone. To that end, this company has concentrated twenty-eight years of tireless effort . . . a lifetime of "firing" upon a common target.

And time has more than proven that in capacitors for power-factor correction, as in all branches of industry, "C-D" means more capacitor value per dollar expended. Literature on request at Dept. C26, 1032 Hamilton Blvd. South Plainfield, N.J.

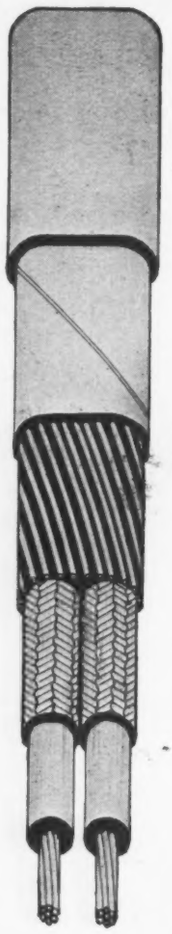
UTILITIES ARE FINDING IN CORNELL-DUBILIER CAPACITORS THE ANSWER TO THE PROBLEM OF INCREASING SYSTEM CAPACITY ECONOMICALLY.

CORNELL-DUBILIER ELECTRIC MACHINERY EM

CORNELL-DUBILIER

WORLD'S OLDEST AND LARGEST MANUFACTURERS OF CAPACITORS EXCLUSIVELY

Capacitors for Power-Factor Correction



SERVICE CABLES

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Write for bulletin.

ROME CABLE
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Mills and executive offices
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Field Reports on Business

The continued low level of activity of business in general is reflected in the electrical trades. Orders are slow, with purchases limited to urgent needs. With the coming of warmer weather hope is held for a seasonal rise in general business.

NEW YORK

Sales records this week will be one day short due to the holiday Monday. However, with the beginning of June and warmer weather, trade is expected to show a seasonal rise. The weather in May failed to aid spring sales because of the rain and rather cool days. For the most part business has been disappointing, with all indices slipping downward. Security prices have responded in a like manner, which has engendered no cheer for new financing.

Failure of power production to show any signs of improvement has caused the utilities to maintain their curtailed budget program of new construction. Buying is mostly in small lots to meet current requirements.

The bright spot in this section is the development of home communities. Several of the large real estate operators are going ahead with new houses, which offer outlets for electrical appliances and lighting fixtures. Great stress is being placed on adequate wiring.

Disappointing to trade has been the downward trend in commodity prices. It is feared in some quarters that the piling up of stocks will lead to further price concessions. Efforts are being made to prevent a stagnation of markets, which results when buyers hold off purchases in anticipation of a further drop in prices.

Sales plans of utilities are being geared to take advantage of the warm weather to move refrigerators and electric ranges. Some success has been noted, with dealers lending every aid.

PACIFIC COAST

May volume of electrical business exceeded April very slightly, but showed a better gross profit rate. Hope is strong, however, for a marked pick-up by August, when a widespread housing program will be actively under way, with such highlights as San Gabriel's construction of 840 frame dwellings near Los Angeles within two years and San Francisco's conference for efficient allocation of the government's $15,000,000 awards by state and government will soon reach the electrical stage over wide area such as electrical installations averaging $20,000 each for high schools and hospitals, a $2,500,000 Mare Island Navy yard appropriation for power plant equipment and an extended distribution system, fifty large and small post offices for California, the larger group averaging $250,000 each, the smaller $75,000 each, and $1,200,000 of building awards by the San Francisco exposition.

The week's outstanding orders come from the Seminoe Dam project at Kendrick, Wyo., and cover $110,000 for poles, $20,000 for crossarms, $225,000 for wire, insulators and hardware and approximately $135,000 for main control equipment. Coast factories making transformers and other power apparatus are affected by aftermath of record winter rains, which have cut pumping equipment sales to half of last year's, but other machinery is moving better than proportionately and includes $44,199 for two Navy alternators size 800 kw.; four 4,000-kva. transformers for San Francisco exposition substation, value $70,000, and three capacitators, value $15,000, for Pacific Gas & Electric Company.

CHICAGO

Business activity throughout the Middle West continues at a slow pace. Practically every line reports declining trend going into the summer months. Retail trade has not shown the normal seasonal pick-up for summer merchandise and is currently running approximately 20 per cent below this period a year ago. The administration's spending-lending program has, so far, failed to stimulate any branch of industry. Its greatest help was to have been psychological, but obviously it has failed to offset the deflation spirit. Most of the predictions in regard to the immediate outlook are of a decidedly pessimistic nature.

Some orders for electrical equipment are being received from industrials which are on the tail ends of construction programs. The majority of these orders average no higher than four or five thousand dollars and include wire, cable, motors and control apparatus. Floodlighting of outdoor athletic fields has picked up sharply in the last few weeks. The steady improvement in the number of electric range installations is encouraging.

Residential construction, particularly in the suburban area, has shown slight improvement during May, although it is still 18 per cent under last year at this time.

NEW ENGLAND

New England business has been somewhat disappointing for the first half year. Buying is spotty, but power equipment and line materials feature recent sales. Bangor Hydro-Electric Company has bought two General Electric 1,875-kva. generating units with switchgear for an extension of its Veazie Hydro plant.

Transformers for line extensions in the Cape Cod area of Massachusetts have been bought. An order amounting to about $15,000, involving switch and control apparatus, was placed last week; several small lots of distribution transformers were purchased a fortnight ago. Orders for potheads and substation material were recently received by one well-known distributor who reports the sale of 348 insulators for line extensions.

Industrial equipment buying is lagging though some interest is noted in special application apparatus. Whitin Machine Works has purchased an electric roll hardening furnace to treat two tons of steel per day. The Hathaway Mills, New Bedford, has installed a Parks-Cramer air conditioning system to handle 659 tons of air per hour in rayon weaving. Some interest reported in electric furnaces and studies are being carried out by one manufacturer relative to special heat treatments for springs and high alloy steel parts. Arc welding equipment is quiet, orders for electric laundrying and washers show large increase among appliance sales for the first half of the current year.

This NEW Synchronous

TIME-SWITCH

will not stop...

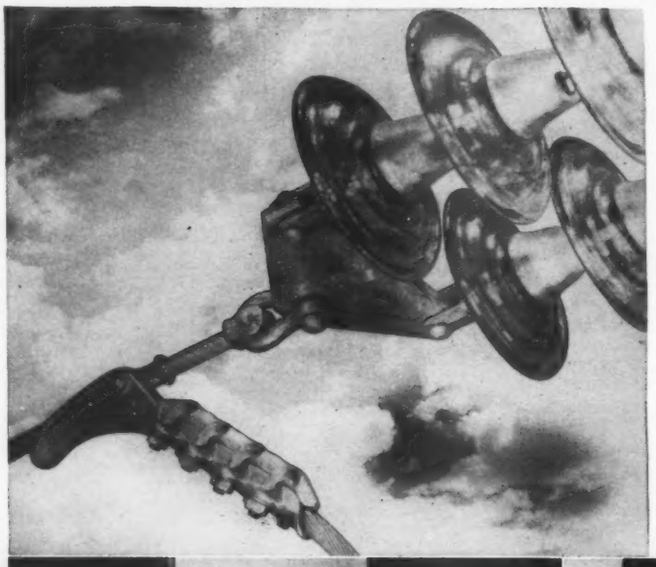
...because the 10 hour carryover feature of SANGAMO FORM VSW assures continued service.

The Model B Forms VSW and VSWZ Time-Switches combine the advantages of synchronous timing with reserve spring clock operation, providing continuous operation during current interruptions up to ten hours. An entirely automatic carryover eliminates the necessity of resetting the dial after the electric service has been restored. Supplied with standard or astronomic dial.

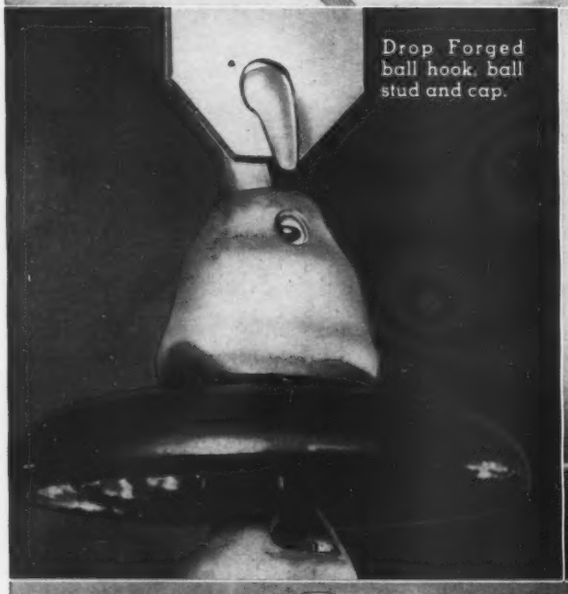
DETAIL DESCRIPTION ON REQUEST

SANGAMO ELECTRIC COMPANY SPRINGFIELD ILLINOIS

Hi-Line Hardware Every



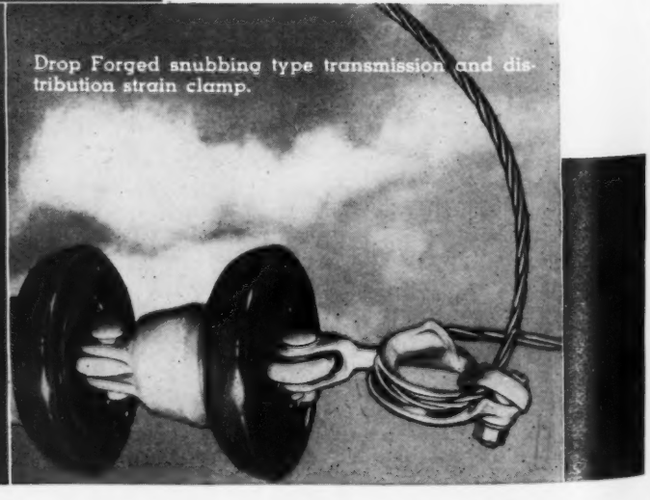
Drop Forged Strain Clamp, double strain yoke set caps and ball studs.



Drop Forged ball hook, ball stud and cap.

Drop Forged heavy duty type suspension clamp.

Drop Forged heavy duty type trunnion clamp.



Drop Forged snubbing type transmission and distribution strain clamp.

Engineer Should Keep on File

Classified and as concise as a directory, this catalog was designed for engineers. It is in blue-print form and void of all flowery descriptive matter. A short treatise is included as a foreword for those interested in forging procedure. A reference book every engineer should keep on file. We will send you a copy by return mail.

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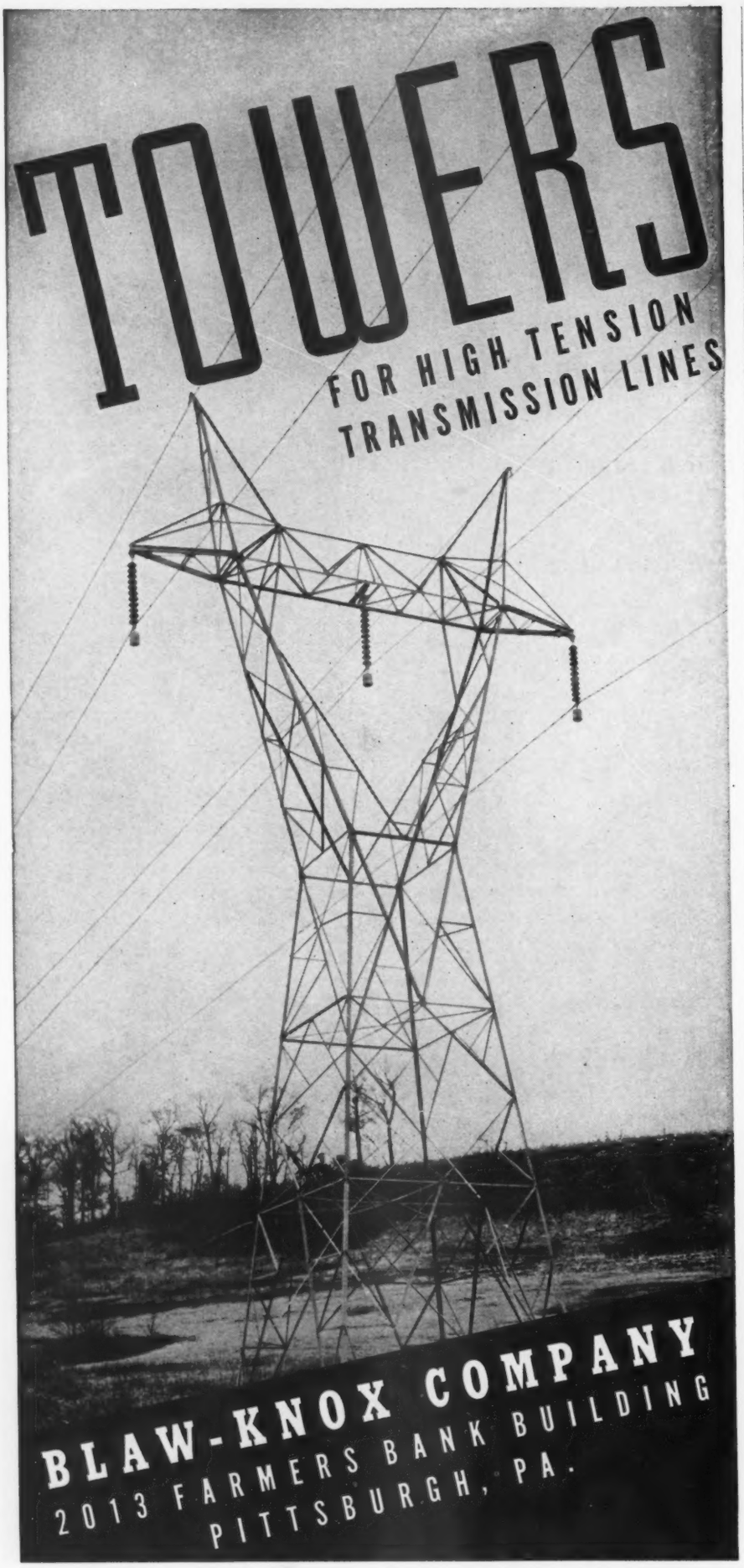


Recent Rate Changes

COMMONWEALTH EDISON COMPANY has filed with the Illinois Commerce Commission a new rate of one cent per kilowatt-hour for electricity used exclusively for water heating, at certain restricted hours of the day. The proposed rate is filed to become effective on June 11 and will be available only to residential and other customers using alternating current. Use of the one-cent electricity will be restricted to "off-peak" periods and will be controlled by a time clock switch or other method. Introduction of a water heating rate in Chicago is another step in the Commonwealth Edison Company's program of broadening the use of electricity in the home. Similiar rates are in effect in other cities in the country.

FEDERAL POWER COMMISSION has announced that it has vacated its order of January 13, suspending a rate schedule of the Kentucky Utilities Company which provides for an increase in the rates and charges to be assessed and collected for electric energy furnished to the Tennessee Electric Power Company and discharged its order of March 8, setting hearing on the suspended schedule. The commission's action followed submission of data and information by the Kentucky company subsequent to the order setting hearing indicating that the rates and charges provided for in the suspended schedule are in substantial conformity with the cost of rendering the service and do not exceed reasonable rates and charges for the service therein provided. The commission's order permits the rates and charges under the suspended schedule to become effective as of January 13, and terminates all proceedings relating to the suspension.

CINCINNATI GAS & ELECTRIC COMPANY has voluntarily cut its rural electric rates, effective June 1. The new rural rate is 7½ cents per kilowatt-hour for the first 20 kw.-hr., declining to 2½ cents on all over 300 kw.-hr. Under the old rate 7¾ cents was paid on the first 30 kw.-hr. and 3 cents on all over 150 kw.-hr. The commission estimated the average rate reduction at 5 per cent.

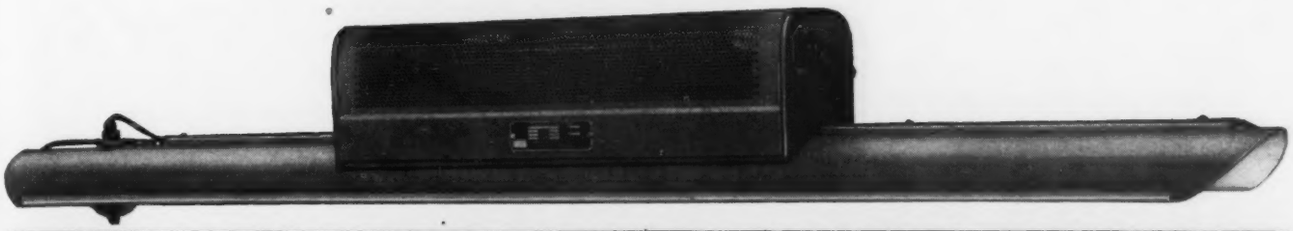
ORANGE & ROCKLAND ELECTRIC COMPANY has filed revisions of its electric rates with the New York Public Service Commission which make reductions in residential and general service rates applicable in the entire territory of the company. The commission permitted the revised rates to become effective and it is estimated that they will save consumers of the company a total of $13,851 annually of which $10,597 will be saved by the residential consumers and $3,254 by commercial customers.

WISCONSIN PUBLIC SERVICE COMMISSION has announced that the city of Evansville, Wis., has reduced the rates of its municipal electrical utility $3,000 annually. New rates for homes include a fixed charge of 50 cents net per month plus 3 cents per kilowatt-hour for the first 50 kw.-hr. used.

CONCORD, N. C., LIGHT DEPARTMENT has announced a reduction in electric rates for customers using electric ranges, refrigerators, and water heaters. Superintendent L. A. Fisher of the department said that the new reduced rates would mean a saving of approximately 16 per cent to those customers affected. The new rates go into effect July 1.

ILLINOIS COMMERCE COMMISSION has announced that esimated annual savings

still "TOPS"



Cooper Hewitt Mercury Lighting

Take it from the man at the bench or on the assembly line—the sharp, clean-cut clarity of sight under Cooper Hewitt lamps still ranks as "tops" for precision work in industry.

These long-tube light sources are naturally low in *glare-factor:* thus, the high illumination levels required for checking fine detail can be achieved without eye-stabbing reflections from bright metal parts. Shadows are virtually non-existent. There's a sense of coolness about Cooper Hewitt light that makes for physical as well as visual comfort.

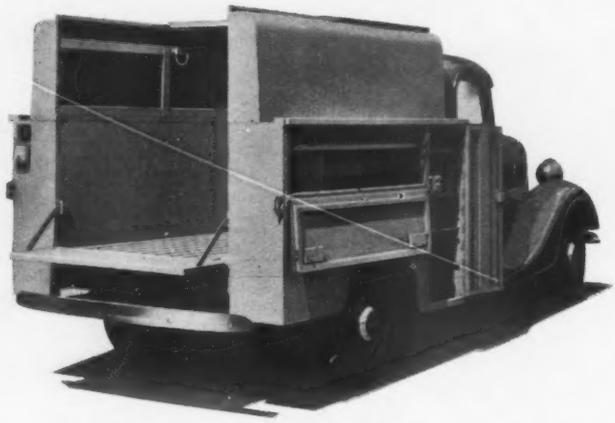
Now, too, with the *new* Cooper Hewitt lamps . . . 22% more efficient than previous types . . . "high see-ability" lighting for inspection or production areas is less expensive than ever before. Plants where *costs are known down to the last penny* are installing Cooper Hewitts right now—as a means of spreading slim modernization budgets *wisely* as well as *widely* throughout the plant.

Why not discuss the possibilities of similar gains in your own plant with a representative who knows the economics as well as the engineering of modern industrial lighting? General Electric Vapor Lamp Company, 805 Adams Street, Hoboken, New Jersey.

GENERAL ELECTRIC
VAPOR LAMP COMPANY

904C

A UNIVERSAL DESIGN REDUCES COST



4460 BODY WITH CANOPY ROOF

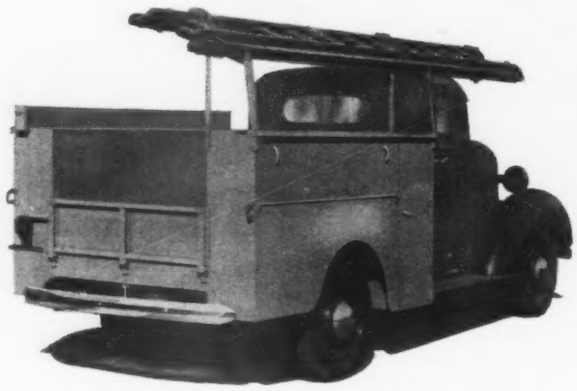
LIGHT LINE SERVICE BODY

Uses in Common

ELECTRIC METER INSTALLATION
GAS METER INSTALLATION
COMBINATION GAS AND ELECTRIC
GENERAL SERVICE

A universal design permits us to standardize our manufacture and effect a considerable saving to buyers of public utility bodies. For the first time in history we offer a price based on the production of 1000 units. Adequate protection is provided for gas or electric meters when carried. The partitions and shelves for each application are fully adjustable.

4460 BODY WITHOUT CANOPY ROOF



APPLIANCE REPAIR BODY

LARGEST EXCLUSIVE MANUFACTURERS OF

STANDARD UTILITIES EQUIPMENT

FOR MOTOR VEHICLES

THE AMERICAN COACH & BODY CO.
CLEVELAND, OHIO

resulting from rate changes in April amounted to $59,789, of which total electric rate cuts amounted to $58,747.

•

Municipal Plants

LONOKE, ARK.—Plans are being discussed for the installation of a municipal light and power plant. A committee has been named by the mayor to study the cost of such a plant. It is hoped to have the plant in operation by the Fall. The city already owns and operates its own water system.

LA JUNTA, COLO.—Proposal for a $497,000 revenue bond issue for a municipal electric power plant was approved by taxpayers in a recent special election. The vote stood at 691 to 554. Voters in April, 1937, voted down a proposed renewal of the Southern Colorado Power Company's franchise. Earlier this year, the company notified the city council it proposed to erect a steam plant for generating electricity if the municipal plant proposal was defeated. The revenue bonds recently approved would be used to finance a Diesel plant of approximately 2,000-kw.-hr. capacity.

GRENADA, MISS.—By a vote of 8 to 1 citizens recently approved plans for bringing TVA power to the city. The vote, 327 to 43, authorized the mayor and board of aldermen "to take such proceedings necessary to secure the benefits of TVA."

COLUMBUS, OHIO—Hearing on a motion of the Columbus & Southern Ohio Electric Company to restrain the city from proceeding with its plans to obtain federal money for a $1,030,000 expansion of the municipal light plant has been recessed indefinitely in common pleas court, following a request by attorneys for both sides, after it was learned that the sinking fund trustees had accepted the $824,000 in bonds to pay the city's share of the cost, subject to the opinion of Cleveland bond lawyers on their legality. It is believed that the bonds are not likely to be approved while the company's suit for an injunction is pending in common pleas court. Since the trustees have tentatively accepted the bonds, the city will not advertise for bids and there will be no immedate need for the restraining order, unless the sinking funds trustees take some affirmative action after obtaining the opinion of the bond attorneys.

ETOWAH, TENN.—Chancellor T. L. Stewart has dismissed a moton to dissolve an injunction prohibiting the city from acquiring a municipal electric power distribution system, ruling that there was a question of the legality of the election held on the public power question last September. Chancellor Stewart upheld three counts in the demurrer of the city and dismissed three others. He gave both sides 30 days in which to appeal from his decision. If there is no appeal the case will be tried on its merits in Chancery Court next September. The injunction has been in effect since last October. City Attorney A. B. Steed said that an immediate appeal to the state Supreme Court would be made. The city is now prohibited from going ahead with plans to acquire and distribute TVA power, so far as a municipal plant is concerned. A TVA-Etowah electric power contract was signed several months ago.

ADAMS, WIS.—Circuit Judge A. C. Hoppmann has sustained the ruling of the state Public Service Commission, which held

Five detours ON A 12½ INCH TRIP!

3 SIZES

TYPE 660 . . . . . FOR VOLTAGES UP TO 8,000
TYPE 670 . . . . . FOR VOLTAGES UP TO 10,000
TYPE 680 . . . . . FOR VOLTAGES UP TO 15,000

Handle most PRIMARY line requirements

"Old Man Outage" just can't get anywhere—there are too many detours and the road is too hazardous for him to travel far.

Regardless of the weather's severity, the unusually long leakage distance of the Series-600 Hemingray Insulators is a guarantee of outage-free performance. Modern design, combined with tough, ageless HEMINGRAY electrical glass and the considerably greater mechanical strength provided by the brass bushing, means long, faithful service.

The Series-600 provide lower initial and over-all costs. Specify them. . . Ask for samples, test them and learn their greater service advantages. Owens-Illinois Glass Company, Hemingray Division, Muncie, Indiana.

World's largest manufacturers of glass containers; and producers of INSULUX Glass Block, DUST-STOP Replacement-Type Air Filters; FIBERGLAS Insulating Wool, Insulating Blankets and Electrical Insulation.

Order HEMINGRAY Glass INSULATORS

For modern power line insulation

Made by OWENS-ILLINOIS *"First in Glass"*

3 good reasons for locating your plant in New York State

WHY do manufacturers continue to bring new plants to New York State? Why do they spend millions enlarging plants already located here? Three important reasons that were responsible for spending millions on business expansion in New York State during 1937:

1. *Abundant, low cost power.* 2. *Nearness to markets.*
3. *Unsurpassed transportation facilities.*

New York State's combination is hard to beat. If you want to know more about this state as a possible plant site, write us today. Our industrial engineers will make investigations for you without obligation. Simply write Niagara Hudson Power Corporation, 15 Broad Street, New York City.

NIAGARA HUDSON

that the city has a right to purchase the electric distribution system from the Wisconsin Power & Light Company. In June, 1930, citizens voted to acquire the utility's property, following which the Public Service Commission approved the purchase and ordered the company to sell. The utility contended that three of its properties and the transmission lines are so connected as to form one plant and that there is no law requiring it to be cut into sections. Judge Hoppmann overruled the utility's contentions.

•

Prepares 1937 Report on Engineering Education

Supported by a grant of $10,000 from the Carnegie Foundation for the Advancement of Teaching, the Engineers' Council for Professional Development has arranged for the preparation and publication of a "Report on Engineering Education in 1937." This will be based on the great amount of information which has been gathered by the E.C.P.D. committee on engineering schools in connection with its investigation for purposes of accrediting engineering curricula in degree-granting institutions of the United States.

The work will be in charge of Dugald C. Jackson, emeritus professor of electrical engineering at the Massachusetts Institute of Technology, and formerly president of the Society for the Promotion of Engineering Education and of the American Institute of Electrical Engineers.

•

Publish Meeting Papers

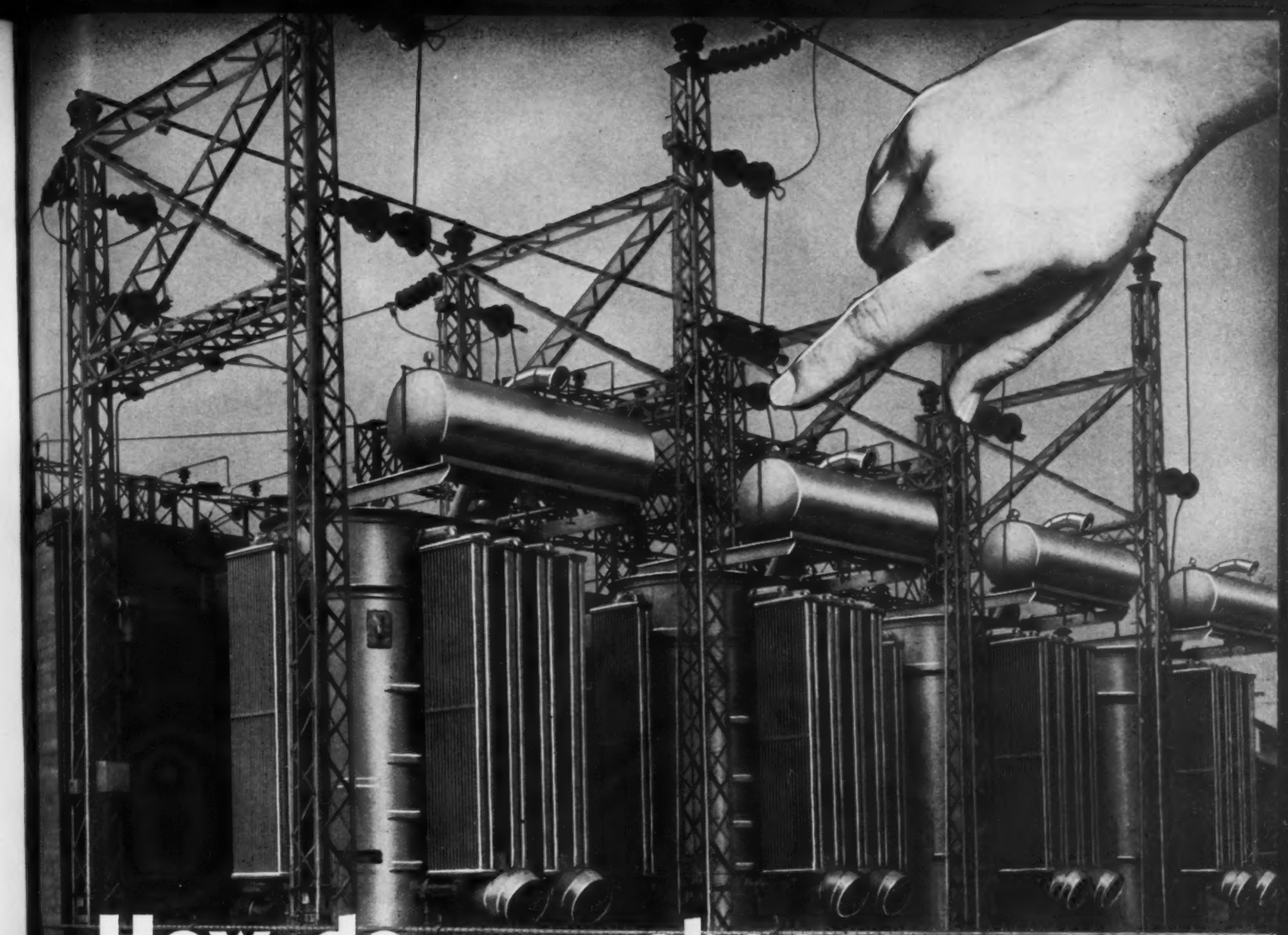
Volume 1 of the proceedings of the Midwest Power Conference, containing papers presented at the three-day meeting, April 13–15, in Chicago, is now available. Copies may be obtained from L. E. Grinter, conference director, Armour Institute of Technology, Chicago.

LIBRARIES—ATTENTION!

Libraries possessing early volumes of "Electrical World" cover-in the great period of electrical development during the 1880's and 1890's should also have the composite index for the years 1883 to 1896.

A few copies of this rare book of 372 pages, long out of print, have recently been discovered. They are offered at the nominal price of $1, merely to cover handling and shipping costs.

Orders should be addressed and checks made payable to "Electrical World."



How do you choose your Transformers?

IS IT a matter of the transformer's performance . . . dependability . . . economy . . . or is it the integrity and reputation of the maker?

Naturally, it is a combination of all of these. But, what about it? Aren't transformers all designed and built in accordance with the same basic principles . . . don't they even look very much alike?

True, the same basic principles apply, and transformers, in general, are quite similar in appearance. But, *how* are those basic principles applied? Are they applied with the idea in mind to just "get by", or are they applied in a liberal manner to provide extra safety and extra dependability?

And after the transformer is designed, are the annealing, the impregnating, the vacuum drying and other extremely important steps carried out fully despite heavy production schedules?

To what types of employees is the work of manufacturing entrusted . . . are they high types of *men* who take pride in the quality of their work?

After the transformer is installed on the job and paid for, does the manufacturer lose interest? In event problems arise, is it difficult to get his immediate attention, or is the manufacturer eager to cooperate and help solve these problems?

Since 1896 . . . when the commercial use of transformers had its beginning . . . Moloney Electric has been growing steadily. This growth has resulted from being able to honestly answer all of the foregoing questions most favorably.

Liberal design, carried out by the highest types of workmen using the best materials obtainable, results in the finest of transformers . . . Moloneys!

MOLONEY ELECTRIC

SAINT LOUIS

TRANSFORMERS

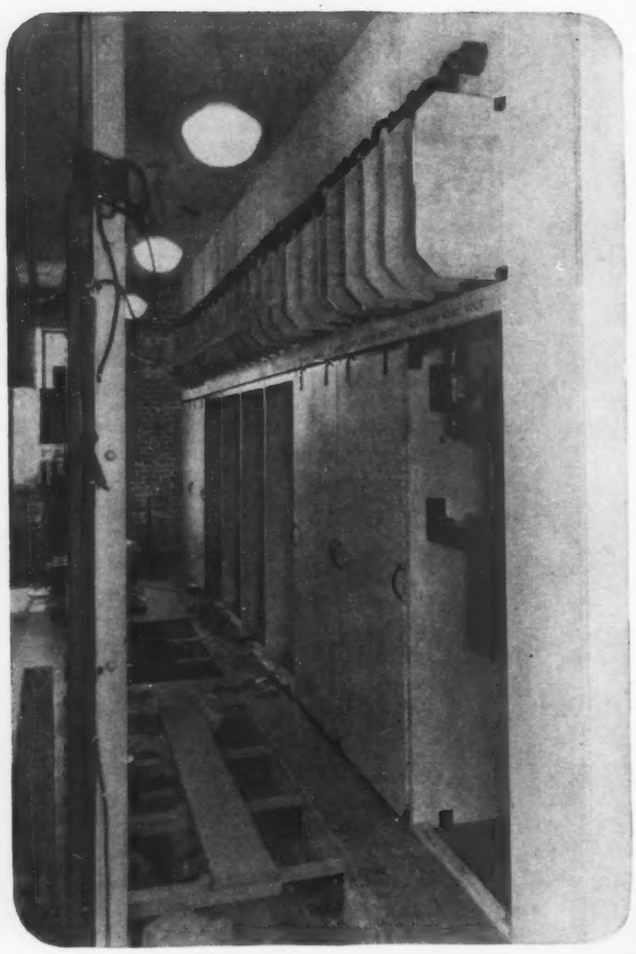
Distribution

with these

Installation and Maintenance Charges are Lowered, Service Improved, Wherever Johns-Manville Electrical Products are Used

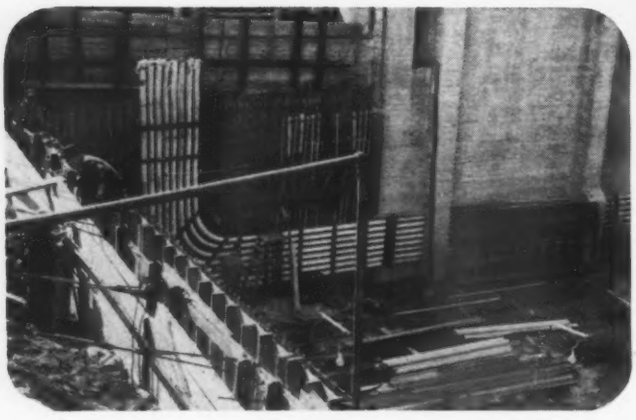
IN the steady drive to cut the cost of electrical distribution, Johns-Manville materials play an important part. The five products shown here, and others in the J-M Line, have proved their ability to give exceptional service at low cost on many types of distribution systems. They are easily installed, reducing original expense, and are practically maintenance-free.

In most cases the great permanence and fire-resistance of J-M Electrical Products are due largely to their asbestos composition. Combined with a heat-resistant inorganic binder, this durable, non-



(*above*) **J-M TRANCELL**, a tough, lightweight cell-structure material, is ideal for housing electrical equipment. Made of asbestos fiber with an inorganic binder and furnished with or without asbestos-cement facing sheets, it is strong, yet easily worked with ordinary tools. Being completely incombustible, it is an excellent fire barrier.

(*above*) **J-M NIAGRITE-ASBESTOMENT**, an economical, easily applied electrical-cable insulation, shields cables from excessive heat and, in case of arcing, protects adjacent cables and equipment from damage.



(*left*) **J-M TRANSITE KORDUCT**, a thin-walled lightweight, economical asbestos-cement conduit, used where ducts are to be "concreted-in." It is incombustible, does not slag under arc, will not adhere to cables under any temperature conditions and has an unusually high rate of heat dissipation. It has the same advantages as Transite Conduit, but is lighter, costs less.

Costs Reduced

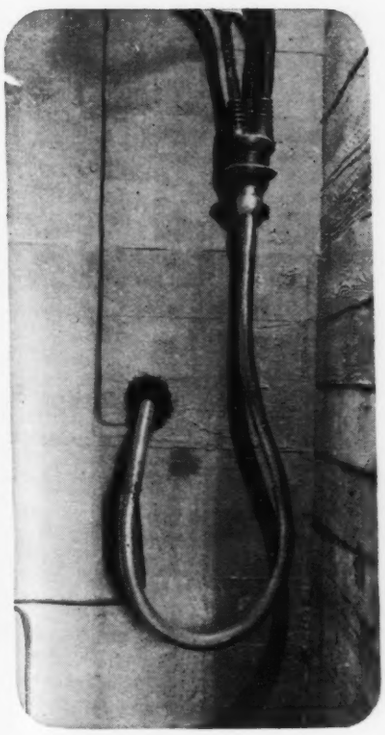
J-M materials . . .

metallic mineral is formed into J-M Trancell . . . a strong, lightweight cell-structure material that is fireproof, easily worked and available in a wide range of styles and sizes. J-M Transite Conduit, a tough, dense asbestos and cement material, is fireproof, weatherproof, rotproof and highly resistant to corrosion. Furthermore, it has such enduring resistance to sustained loads that it can be laid without a concrete envelope. Transite Korduct, thinner walled but otherwise identical to the conduit, is a companion product for use when "concreting-in" is necessary.

And the other J-M products...including Niagrite-Asbestoment Cable Fireproofing and J-M Duxseal for sealing duct openings . . . also bring longer life, greater safety and lower installation and maintenance costs to electrical-distribution systems.

May we send you full information on all J-M Electrical Products? Write for D. S. Series 400. Johns-Manville, 22 E. 40th St., New York, N. Y.

(*above*) **J-M TRANSITE CONDUIT,** an asbestos-cement duct of exceptional strength and durability. Can be laid underground without concrete, greatly reducing installation costs. Because it is fireproof and weatherproof, it is ideal for exposed locations. Highly corrosion-resistant, inside and outside . . . practically maintenance-free.



(*left*) **J-M DUXSEAL,** for sealing duct openings from manholes to consumers' premises, etc., is a non-hardening putty that is unaffected by gases, moisture or temperature changes; will adhere to any duct or metal surface and is not injurious to workmen's hands or non-metallic cable sheaths.

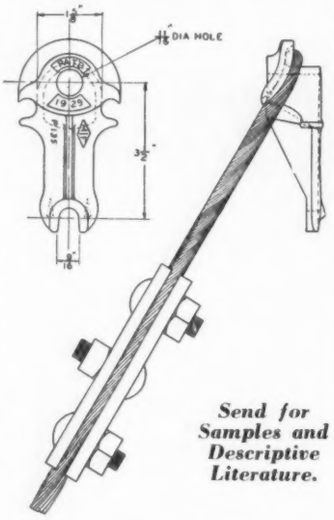
JOHNS-MANVILLE JM PRODUCTS

Johns-Manville

ELECTRICAL PRODUCTS

Modern Economical Through-bolt Guying

Users of 200,000 M. I. F. Through-bolt Guy Hooks during 1937, including a majority of the operating companies in the U. S. and Canada, tell us their anchor guy construction has been simplified and improved with considerable savings over former methods. Operating Superintendents and Engineers sending us data on guy strand sizes and ratings will receive in return samples with specific recommendations.



Guy Hooks — Three principal types in addition to the P134 Crossarm Guy Hook. P135 rated at 13,000 lbs. on ⅝" through-bolt is also approved for R.E.A. projects. P133 rated at 20,000 lbs. on ¾" through-bolt. P132 rated at 40,000 lbs. on 1" through-bolt. Make up guy loops on the ground and save time of the whole gang. Prices as low as 15¢ each in quantity.

Eye Nuts & Anchor Rods — Thimbleless Eye Nuts for ⅝" bolt as low as 12¢ each in quantity. Larger sizes for ¾" and 1" bolts. Also furnished assembled and galvanized as unit on special steel rods of any desired length, rated at 80,000 lbs. per sq.in., at correspondingly attractive prices. Double Eye Nuts and various types of Bolt Eyes also available.

Curved Washers — Full line of Curved Ribbed Malleable Washers using the metal to better advantage than plate washers of uniform thickness and strictly competitive as to price.

Send for Samples and Descriptive Literature.

Misc. M.I.F. Pole Hardware Specialties — *Williams Pole Mounts — Pole Stubbing Clamps — Aerial Cable Messenger Clamps and Insulated Hangers — Malleable Secondary Racks and Clevises — Malleable Crossarm Gains — Transformer Gain Plates and Kick Arms, etc.*

MALLEABLE IRON FITTINGS COMPANY
Pole Hardware Dept. [Factory and New England Sales Office] Branford, Connecticut
New York Sales Office: Thirty Church Street
Canadian Mfg. Distributor:
LINE & CABLE ACCESSORIES, Ltd., Toronto

LANCERS OF THE LINES

Economical Line Clearing

Uniformed operators represent uniformly high craftsmanship.

Write for "LINE CLEARING"

ASPLUNDH
TREE EXPERT COMPANY
JENKINTOWN, PENNA.—OGONTZ 3750

CHICAGO, ILL.
Randolph 7100
BINGHAMTON, N. Y.
Binghamton 4-5314
COLUMBUS, OHIO
Adams 5432
ALEXANDRIA, VA.
Alexandria 1622 J

Sales Opportunities

CANTON, OHIO—Ohio Power Company, Newark, Ohio, has plans nearing completion for new power substation at Canton, including transmission line connections for increased local distribution. Work is scheduled to begin at early date.

CHATTANOOGA, TENN.—Chattanooga Electric Power Board has plans nearing completion for installation of section of new municipal electric distributing system, to include poles, line hardware and fittings, wire and cable for 12.5-kv. and 4-kv., primary lines, 115-230-volt secondary lines, feeder lines for street-lighting system, lighting standards, etc., at estimated cost of $250,000. S. R. Finley is chief engineer for Board.

ANNAPOLIS, MD.—Bureau of Yards and Docks, Navy Department, Washington, D. C., is asking bids (no closing date stated) for extensions and improvements in electric system at Naval Academy, Annapolis (Specifications 8722).

NEW YORK, N. Y.—General Foods Corporation, 250 Park Avenue, plans installation of motors and controls, regulators, conveyors, electric hoists and loaders, and other equipment in connection with an expansion and improvement program at different plants in various parts of country during 1938, to represent a total expenditure of close to $7,000,000, for which financing is now being arranged. Project will include several new plants, including one at Hoboken, N. J., to cost over $2,000,000, and new corn mill at Kankakee, Ill., to cost in excess of $1,000,000.

CULVER, IND.—Culver Educational Foundation, Col. C. C. Chambers, secretary, plans extensions and improvements in power plant at local Culver Military Academy, including installation of new electric generator unit and accessories, 625-hp. watertube boiler, transformers, motors, pumps and complete auxiliary equipment. Appropriation is being made for work and bids are scheduled to be asked soon.

GUNTERSVILLE, ALA.—Director of Purchases, Tennessee Valley Authority, Knoxville, Tenn., receives bids until June 16 for auxiliary power and lighting switchboards for hydroelectric generating station at Guntersville.

CARROLLTON, MO.—Is considering report made by Burns & McDonnell Engineering Company, 107 West Linwood Boulevard, Kansas City, Mo., consulting engineer, for new municipal electric light and power plant, with cost estimated at $235,000.

BREMERTON, WASH.—Bureau of Yards and Docks, Navy Department, Washington, D. C., will prepare plans for extensions and improvements in power plant at Puget Sound Navy Yard, estimated to cost $450,000, with equipment, and for extensions and modifications in electrical distributing system at same yard, estimated to cost $300,000, with equipment. Appropriations are being arranged through supplemental naval budget for fiscal year 1938-39.

FAYETTEVILLE, TENN.—Receives bids until June 17 for new municipal electrical distributing system, including power substation facilities and transmission line connection with system of TVA, from which power will be secured. Fund of $115,000 is available. Lide & Adler, Woodward Building, Birmingham, Ala., are consulting engineers.

BUFFALO, N. Y.—National Gypsum Com-

Modernization

..to render modern
..to bring up to date
..to adopt new ideas

NATURALLY, the purpose of any modernization program should be to gain an economic advantage by increasing plant efficiency and quality of service.

Our organization has been carefully trained to analyze conditions from the customer's point of view. As a result many prominent companies have given us the opportunity to help solve their individual problems with the proper selection of transformers designed for their specific needs.

This policy has helped us develop basic improvements in large transformers for power transmission, for heavy industrial service, for electric furnace use, for heavy welding processes and other requirements. And, in the distribution field we have introduced a transformer which has rapidly gained a wide acceptance in the industry.

Pennsylvania believes it can help you in *your* modernization program.

Write for Bulletin 340 (Power Transformer) and Bulletin 350 (Distribution Transformers).

PENNSYLVANIA TRANSFORMERS

Offices in All Principal Cities

Pennsylvania TRANSFORMER COMPANY

1701 Island Ave., N. S. Pittsburgh, Pa.

Murder or Accident?

Regardless of what caused this miniature avalanche, the miner's life was saved by a miner's helmet made from sturdy Diamond Fibre.

It's not likely that you manufacture miner's safety hats . . . but they serve to illustrate the versatility of Diamond Fibre and the resourcefulness of the men who make it. In this instance a light, thin shell of tremendous mechanical strength was specified — strength that had to withstand *50 blows from an 8½ lb. steel ball dropped 7½ ft. without rupturing* the finished helmet. The same brains and experience that solved this problem are available at all times to you—and without charge. Write us how we can serve you best.

CONTINENTAL-DIAMOND FIBRE CO.

Newark, Delaware

Represented in Canada by DIAMOND STATE FIBRE CO. OF CANADA, LTD., TORONTO

DILECTO

A laminated plastic, commonly known as phenol fibre, made in sheets, rods and tubes or fabricated parts to specifications. Has high electrical insulation properties, great resistance to water, practically unaffected by oil or mild acids. It is a strong, tough material with a wide application for use in connection with modern electrical appliances.

DIAMOND VULCANIZED FIBRE

A tough, economical, insulating material made in standard sheets, rods and tubes. Can be readily fabricated or formed. A material of countless applications.

VULCOID

A thermo-plastic, non-hygroscopic insulating material made in standard sheets, rods and tubes. It is strong and tough, has good electrical insulating properties and is readily fabricated.

MICABOND

Thin splittings of mica bonded together with specially developed binders into standard plates, tubing or in formed rings, punched and sawed segments or other special parts. Micabond has high dielectric strength, is practically unaffected by acids, has high heat and moisture resistance, is readily punched, sawed or formed.

CELLULAK

A laminated form of insulating tubing, possessing extremely high dielectric properties, and marked resistance to flash-over.

DILOPHANE

A translucent, laminated plastic in colors. It provides perfect light diffusion, is not inflammable, and is manufactured in practically any color imaginable with either a glossy or dull finish.

pany, 190 Delaware Avenue, plans installation of motors and controls, conveyors, transformers and accessories, and other equipment in proposed new multi-unit gypsum plaster and board mill for which site will be selected soon at point in South, near Atlantic seaboard. Fund of $900,000 is being arranged for plant, through bond issue of $3,500,000, recently authorized.

BUFFALO, N. Y.—Buffalo-Niagara Electric Corporation has completed plans and will proceed with construction of new power substation and switching station for high-tension system at Littell and Archer Streets, where tract of over 15 acres of land has been selected. It will be known as Seneca switching station and is estimated to cost over $1,200,000, including transmission line extensions and connections.

STARKVILLE, MISS.—Plans early call for bids for a municipal electrical distributing system, including transmission line connection with TVA high-tension system, from which power will be secured. Financing has been arranged through Federal aid.

MOUNT PLEASANT, IOWA—Mount Pleasant Electric Light & Water Works plans extensions and improvements in steam-electric generating plant, including installation of a 1000-kw. turbo-generator unit and auxiliary equipment. A hearing has been called June 15 to approve project.

ENDICOTT, N. Y.—International Business Machines Corporation, 590 Madison Avenue, New York, N. Y., plans installation of motors and controls, conveyors, regulators and modern factory lighting system in new three-story addition, 160x450 feet, at main plant at Endicott, near Binghamton, N. Y., to be used primarily as a machine shop. Cost about $700,000.

WASHINGTON, D. C.—Bureau of Yards and Docks, Navy Department, Washington, receives bids until June 8 for turbo-alternator condenser unit and complete accessories (Specifications 8733).

TEKAMAH, NEB.—Burt County Rural Public Power District, Tekamah, R. V. Miller, secretary, plans new transmission line from Fremont, Neb., where connection will be made with power substation and switching station of Loup River Public Power District, to connection with main transmission system of Burt County district, close to 30 miles. Application has been made for permission. H. H. Henningson Engineering Company, Union State Bank Building, Omaha, Neb., is consulting engineer.

•

$1,000,000 for Vacations

Completing twenty years of paid vacations for hourly-paid employees, Westinghouse Electric & Manufacturing Company reports that approximately $1,000,000 had been spent on vacations last year. Two-week vacations with pay were originally granted in 1917 to all hourly-paid employees with a total of twenty years service. Three years later the plan was extended to include those with ten years service. This vacation program was expanded last year, giving paid vacations of one week to those employees with five or ten years service and two-week vacations to employees with ten or more years service.

The Basic Ingredient of "PRUDENT MODERNIZATION"

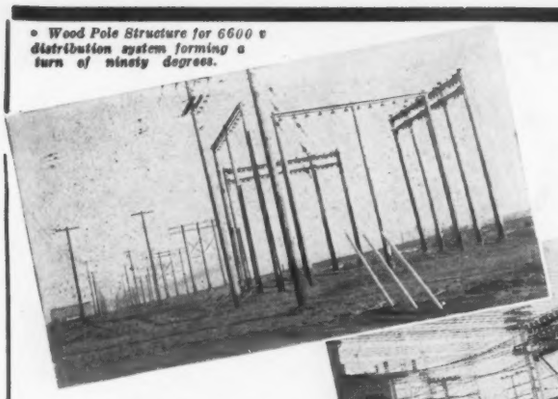
"We should never forget that the quality and attractiveness of the service we have to sell depends upon

...THE DESIGN AND EFFICIENCY OF THE EQUIPMENT FOR THE GENERATION, DISTRIBUTION AND CONSUMPTION OF THAT SERVICE"

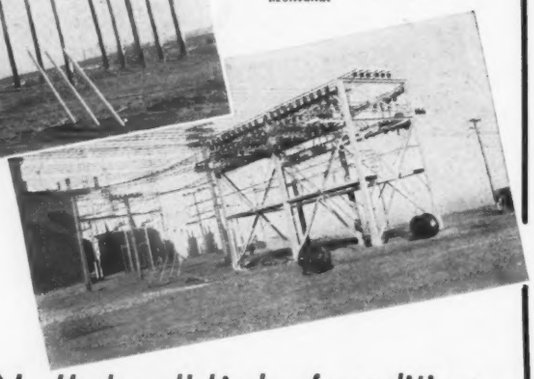
President C.W. Kellogg
before the Sales Conference
of Edison Electric Institute

● SINCE 1896 – ELECTRICAL TESTING LABORATORIES *(NEW YORK CITY- EAST END AVE. AT 79th. ST.)* HAS CO-OPERATED WITH MANUFACTURERS AND UTILITIES TO THE END THAT THIS QUALITY AND ATTRACTIVENESS MAY CONTINUE TO CHARACTERIZE CENTRAL STATION SERVICE.

• Wood Pole Structure for 6600 v distribution system forming a turn of ninety degrees.



• Steel Switching Tower erected at Fort Peck, Montana.



EXPERTS ON NEW CONSTRUCTION *Under all kinds of conditions*

A. S. SCHULMAN ELECTRIC COMPANY
537 S. Dearborn Street
CHICAGO, ILL.
FOUNDED 1890

• The Schulman organization of erection specialists has had more than 50 years of experience in power line rehabilitation and construction projects. Trained crews and modern equipment for low-cost construction, in the quickest time, are immediately available. Let us submit quotations and consult with you on your next requirements.

STEEL TOWER • • • WOOD POLE LINE CONSTRUCTION
SWITCHING STRUCTURES • SUBSTATIONS • POWER HOUSES

VICTOR

makers of

GOOD

INSULATORS

VICTOR

INSULATORS, INC.

VICTOR, NEW YORK

New York Convention Gets Municipal Utility Proposal

A proposal to the New York State Constitutional Convention, now in session, has been made by Judge Gilbert V. Schenck, Albany delegate, which provides that the Legislature shall pass no measure prohibiting any municipal corporation operating public utility service from making and receiving a fair return on the value of the property used and useful in such public utility service.

It is also provided that no measure shall be passed prohibiting the use of profits resulting from operation of public utility service for payment of expenses or obligations incurred by such municipal corporation for municipal purposes. The bill went to the public utilities committee.

•

Hydro Contract Approved

Bondholders of Maclaren-Quebec Power Company, constituting a quorum, at a recent meeting held in Montreal unanimously sanctioned the power contract with Ontario Hydro-Electric Power Commission as modified last December and agreed to postponment of sinking fund payments for seven years. Albert Maclaren, president, pointed out that the modified contract, in order to be valid, had to be approved by bondholders' trustee and by the Ontario Legislature prior to July 1, 1938. The validation act by the Ontario Legislature, was passed recently.

•

Completes Power Station

Rock Rapids, Iowa, completed last fall the construction of a $270,000 municipally owned and operated power plant and changed the current over to alternating. Direct current was in effect in the city since 1897, it was reported. In the change-over all radios were replaced on an exchange basis, motors were replaced by the city. C. W. Eppard is general superintendent.

•

Customers to Get Refund

Under a recent order of the Wisconsin Public Service Commission, Interstate Power Company of Wisconsin will refund approximately $40,000 to customers in eleven Grant and Crawford county communities for advances made toward cost of extending electric service. The refunds will be made over a five-year period by crediting customers' bills with an amount not more than one-third of the bill. If a balance remains at the end of this period it will be paid in cash or merchandise.

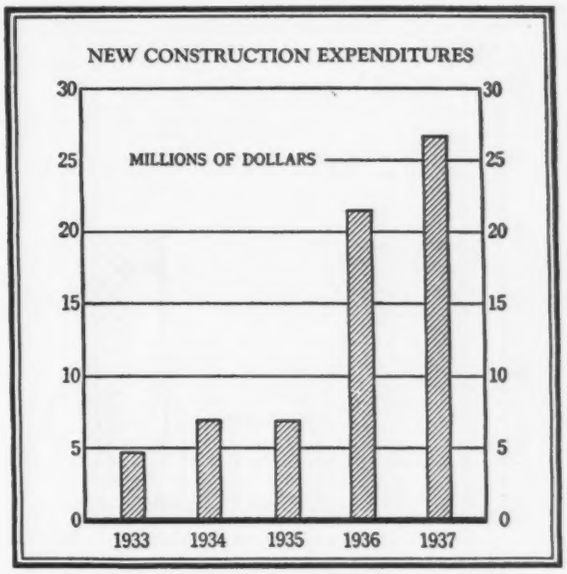
MODERNIZATION AND EXPANSION

. . *a forward-looking policy*

New times demand new methods as well as enlarged, improved facilities to serve increasing needs. To meet these requirements, Columbia System annually spends millions of dollars. For the years 1936 and 1937, the gross cost of additions to its fixed property totaled $48,131,000. The increase in new construction expenditures made during this period, compared with those of recent previous years, is graphically shown in the chart below.

A Program of Progress

Long-range planning is an important part of Columbia's program of progress. It is exemplified in additions to electric generating capacity and sub-station equipment; in the installation of high pressure boilers with large steam-producing capacity; in improvements designed to protect electric generating stations against flood conditions even more severe than those which were experienced in the Cincinnati area early last year.



Among other important projects, there was completed recently, in West Virginia, a 16″ natural gas pipe line approximately 92 miles in length, with a 3,375 h.p. compressor station and appurtenant equipment.

Thus does Columbia System provide for increased capacity for both gas and electric service . . . in accordance with forward-looking management policies dedicated consistently to the public interest.

COLUMBIA SYSTEM

COLUMBIA GAS & ELECTRIC CORPORATION

BIAS TAPES
with plenty of
STRETCH!

ACME bias tapes fit snugly around corners, into slots and over uneven surfaces because they have exceptional flexibility (stretch), and the tensile strength to stand the pull. These qualities are due to an Acme-developed process of applying pure vegetable oil varnishes of Acme formula to highest grade cotton fabric. Available in bias or straight tapes and rolls up to 36" wide — yellow or black. Samples if desired.

Acme Wire PRODUCTS

The Acme Wire Co., New Haven, Conn.
MAGNET WIRE—COILS—VARNISHED INSULATIONS—CAPACITORS

for Low Cost Maintenance

"DIXIE" POLES

CREOSOTED or "WOLMANIZED"

They're all dense longleaf yellow pine. Straight and strong. Uniform size. Properly graded. They take maximum penetration under vacuum-pressure. Four modern treating plants strategically located assure prompt deliveries on schedules of any size.

For quotations, address:

JACKSON LUMBER COMPANY
LOCKHART, ALABAMA
A CROSSETT WATZEK GATES INDUSTRY

March Energy Sales Drop

Total sales of energy to ultimate consumers by eleven large electric utilities in Illinois amounted to 554,751,312 kw.-hr. in March, 1938, as compared with 615,067,860 kw.-hr. for the corresponding month of the previous year, a decrease of 9.8 per cent. The March, 1938, sales exceeded the February total by 0.2 per cent. This is the fourth consecutive monthly report showing decreases in total sales to ultimate consumers and the first monthly report since its inception in May, 1935, which revealed decreases for every company in the yearly comparisons.

•

Investors to Organize

American Federation of Investors has started a national drive to enroll a million members, Dr Hugh S. Magill, president, has announced. The federation, whose headquarters are in Chicago, is a non-partisan organization, incorporated in Illinois, for the protection of the nation's investors.

•

Drops Limited Costs Bill

Gov. Richard W. Leche has announced that at the request of the Louisiana Public Service Commission the administration has discarded its plan to limit utility investigation charges to $500 a month. The Governor had stated previously a bill would be introduced in the Legislature amending a present law which allows the Public Service Commission to charge a utility costs of investigating its rates. The present law sets no limit on the costs which may be charged, but gives recourse to the courts in case the utility considers the charges too high.

•

British Output Increases

Official returns rendered to the British Electricity Commission show that 1,849,000,000 units of electricity were generated in Britain during April, compared with the revised figures of 1,832,000,000 units in April, 1937, representing an increase of 0.9 per cent.

•

Connecticut Asks REA Funds

New London (Connecticut) County farmers have filed application for a $50,000 REA loan to be used for construction of rural electric power lines. The project would serve 150 additional farms which are now without electricity and will add 50 miles of power transmission lines.

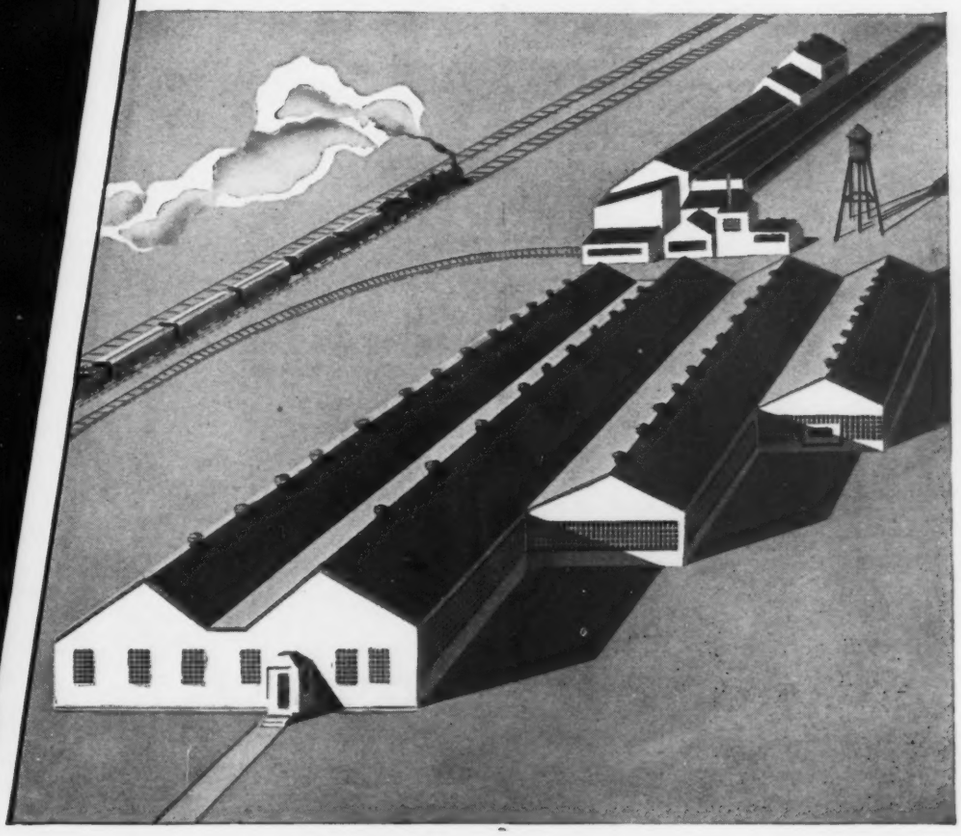
TAYLOR

VULCANIZED FIBRE • PHENOL FIBRE
TAYLOR INSULATION • SILENT GEARS

Increased demand for Taylor products called for greater manufacturing capacity . . . was met by new buildings recently completed, thousands of feet of additional floor space, new processing equipment, and a complete paper mill that is second to none in the quality of its output.

Taylor "Planned Service" is geared to meet requirements, large or small, standard or special . . . can be relied on, always, as an unfailing source of supply . . . permitting *you* to operate with smaller inventories. Ask for more information.

TAYLOR FIBRE COMPANY
NORRISTOWN, PA.



LINCOLN DEMAND METERS
NO PARTS THAT WEAR
Bimetallic coils and center shaft of actuating element
In the above illustration the arrows indicate the only points of possible wear in the actuating element. Even here the motion is little. There is no appreciable wear in years of service.
TYPE WD
SEND FOR YOUR COPY OF CATALOG TO
LINCOLN METER COMPANY
SPRINGFIELD, ILLINOIS

System-Wide Developments Mark Eastern Utility Modernization

[*Continued from page 110*]

eliminate the voltage dips entirely. After considerable study it was decided to install a series capacitor (Fig. 8) to neutralize the effect of the reactance drop in the line. This installation, together with necessary line rearrangements, was made at a cost of approximately $10,000.

A number of improvements in line construction have been adopted in recent years in an effort to improve service and reduce costs. For rural extensions where future development is anticipated the company has adopted the practice of making the initial installation with span lengths of 250 ft. in anticipation of eventually installing intermediate poles to provide the standard span length of 125 ft. required for heavier lines. In order to improve appearance and reduce maintenance on overhead service connections company engineers have developed a new type of concentric service cable which fulfills both of these requirements. The lower first cost, coupled with its longer life, have effected a marked reduction in average cost per service.

Underground Distribution—For many years the company has carried forward a program covering the replacement of heavy overhead distribution construction with underground distribution equipment in the downtown business areas of the large municipalities. In recent years the program has been expanded to provide this type of service in the smaller municipalities and also in neighborhood business areas and on the arterial thoroughfares throughout the territory. Since 1930 the total extent of underground distribution has been increased from 129.4 street-miles to 192.6 street-miles, or approximately 50 per cent.

Extension of underground into the lighter load areas was made economically possible by the complete revision of the established underground construction standards. The 120-208-volt secondary network system has been adopted as standard for all new underground installations in order to provide a maximum of service reliability. Economies have been effected by the use of combination primary and secondary neutral conductors, non-leaded secondary cables and the reduction in size of the manholes and number of ducts per conduit line. Typical business streets where service recently has been placed underground are evidence of the fact that such installations represent a distinct con-

HISTORIC CHARACTERS BROUGHT UP-TO-DATE

Solomon, King of Israel, 10th Century B. C., made a name in history by threatening to divide a child equally to prove its parentage.

Good old Sol has been pointed to as the No. 1 wise man ever since he proved the parentage of a babe by threatening to split it equally with his waving scimitar. He had a gift for knocking out correct decisions and we have an idea that if he were asked today which wire would be best under high temperatures, he'd probably unlimber the old slicer, cut into the insulation, make current carrying capacity and flame tests . . . and then come out in favor of Rockbestos!

You can pull a Solomon too if you have any doubts about Rockbestos asbestos insulated wires, cables or cords. Send for samples and dissect them. Slit back the *asbestos* braid and see how tough it is. Satisfy yourself that the dense, seamless, felted *asbestos* walls adequately heat-seal the hi-dielectric insert. Stick it in oil or grease. Expose it to corrosive fumes. Give it flame, heat and dielectric tests . . . and then you'll know that it's built to do a real job in a tough spot.

If you have an unusual wiring problem we'll be glad to see what we can do on it without obligation. Perhaps one of our more than fifty standard constructions will answer your purpose, but don't hesitate to write whether you want samples, information, or a catalog. Rockbestos Products Corporation, 889 Nicoll St., New Haven, Conn.

Also refer to Electrical World Buyer's Reference Number of 1938.

ROCKBESTOS A.V.C.—*the wire with permanent insulation*

At Last!

SCREWLESS · SHOCK-PROOF · LAMPGUARDS

Work Safely With *SAFEGUARDS*

100%

INSULATED

APPROVED

ECONOMICAL

Now you can solve your lamp guard problem—once and for all—with these lighter, safe, *fibre* LAMPGUARDS. They're easier to use . . . finger pressure on easy rolling, solid rubber ring fastens or releases fibre guard from handle. No glare in workmen's eyes—less breakage—no wearing parts—swivel hook. *Save* and *profit* by using SAFEGUARDS on all your trouble lamps.

SAFEGUARD

ELECTRIC COMPANY, INC.

1 DeKalb Avenue

Brooklyn, N. Y.

tribution to civic betterment, as well as service improvement.

Prior to 1928 all underground installations were of the radial type, having separate transformers and secondary mains for power and lighting service. Since 1928, 81.2 street-miles of the older underground system have been converted to the network type (Fig. 9) of supply, thus bringing the benefits of the modern type of service to customers in the most important commercial areas. It is now planned to continue this program at a rate which will effect the change-over of all of the remaining radial systems within a few years.

Customers' Service and Metering—For the past three years the company has been engaged in a systematic program covering the modernization of customers' meter installations (Fig. 10). For this purpose special meter inclosure and entrance switch cabinets have been developed which provide a maximum of safety to the customer, afford greater convenience for the routine testing of meters and minimize current diversion. To date 106,000 inclosures have been installed under this program.

Transportation Equipment—Within recent years many of the older types of heavy line trucks have been replaced by modern trucks designed to take full advantage of the rate of speed allowed by law. The older trucks were able to travel only 12 to 15 miles per hour, while the modern trucks are designed with power brakes to operate at a maximum of 40 miles per hour. The reduction in traveling time thus effected has materially increased the average daily working time of the line gangs. In certain instances it has made possible the abandonment of small headquarters units in outlying territories and has effected economies by the centralization of line construction and maintenance operations. The latest development in heavy transportation equipment is the line truck equipped with a seven-man cab.

Service and Office Buildings and Equipment—As a result of careful study of distribution service operations in the territory surrounding Newark, it was found that the work centers for all activities such as line maintenance, meter testing, street lighting inspection, etc., for the two operating districts had shifted materially since the original service buildings were constructed. Moreover, it was found that appreciable economies could be effected by the centralization of all activities at a single headquarters, lo-

LITTLE TIME LEFT TO SHARE IN

$2,000

CASH PRIZES!

Two more of the big electric water heater cash prize contests close shortly. Better get busy and enter now. There's still time—and plenty of money to win!

$460 For letters from retail salesmen of utilities and dealers on "How I Sell Electric Water Heaters." A contest each month through 1938.

$250 For the best electric water heater window displays by utilities and dealers. Contest closes June 30, 1938.

$400 For the best newspaper advertising campaigns on Electric Water Heaters by utilities and dealers. Contest closes July 31, 1938.

$1,000 And a silver cup as national awards for the operating utility company that does the best all-around electric water heater job in 1938.

DETAILED INFORMATION

and contest rules have been released to all operating utility companies and local Modern Kitchen Bureaus. Ask for information or write to

NATIONAL ELECTRIC WATER HEATING COUNCIL

THE MODERN KITCHEN BUREAU

420 LEXINGTON AVE.

NEW YORK, N. Y.

The Never-Ending Test

EVERYONE knows the tradition that rules the theatre in time of emergency: "The show must go on!" The utilities industry may well thank the theatre for a phrase that epitomizes its own working code.

With us, too, the show must go on—twenty-four hours a day, three hundred and sixty-five days a year. For our show to stop is not, as with the theatre, merely to deprive an audience of entertainment. The essence of our drama is human health and happiness, the necessities of life—sometimes even life itself.

So each of us has learned to know this: no matter what the sacrifice, *our* show must go on! That idea dominates us during every waking hour. Men in the utilities industry have died to perpetuate the tradition.

We are not often vocal about it during the day's work. Yet it is always there: in the minds of the field force when they fight storms, floods and blizzards; of the station men as they listen to the hum of generators; of executives as they ponder problems of industrial tendencies, economic trends, governmental policies.

The show must go on! How we meet that challenge is the never-ending test of our right to survive.

The American utilities industry has met that test in the past with noteworthy success. It is prepared to meet it even more successfully in the future.

The show *will* go on!

PHILADELPHIA ELECTRIC COMPANY

IT HOLDS ITS GRIP

You'll find this tight-gripping friction tape pliable and easy to handle. It has been treated with special mineral softeners to keep it plastic... prevent hardening, adhere firmly. Comes in full-measure rolls of guaranteed footage.

FRICTION TAPE AMAZON-VICTOR-STICKA

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STEEL STRAND ❖ TELEPHONE WIRE

Crapo GALVANIZED PRODUCTS

SPECIFIED BECAUSE OF PROVED PERFORMANCE

Crapo Galvanized Steel Strand has earned its enviable reputation for long, dependable, economical life by outstanding performances in actual service. That's why it so often is specified by leading utilities for the more important construction jobs. The heavy, uniform, pure zinc coating—applied by the *Crapo* Process—is notable for its adhesion and ductility; its ability to withstand bending and twisting; its lasting resistance to corrosion. Both the finished strand, and the wire from which it is made, conform in every detail to the most rigid specifications for tensile strength, elongation, size, galvanizing and ductility.

Crapo Galvanized Strand is readily available in all standard grades and sizes. Ask your Jobber, or write direct for technical details!

INDIANA STEEL & WIRE CO.
MUNCIE, INDIANA

cated outside of the congested downtown area. The company owned a suitably located building which, at the time, was occupied by other departments whose work was in no way influenced by geographical location. By transferring these departments to one of the older distribution buildings it was possible to release sufficient space to accommodate the consolidated distribution forces of the two original districts. A small expenditure was necessary to provide office and meter department equipment, truck loading platforms (Fig. 11), and outdoor storage facilities.

•

Rural Grants Made to Finish Projects

Allotments have recently been made by REA to complete the following projects and to defray certain expenses connected with the initial operations of the project which cannot be covered by the construction loans.

LOUISIANA—Teche Electric Membership Corporation, Franklin, $7,000. Project previously allotted $95,000 to build 113½ miles of line, 350 customers in St. Mary and Iberia Parishes.

MONTANA—Jefferson Valley Rural Electric Co-operative, Inc., Whitehall, $3,000. Project previously allotted $50,000 to build 40 miles of line, 112 customers in Madison and Jefferson counties.

NEBRASKA—Buffalo County Public Power District, Kearney, $12,000. Project previously allotted $212,000 to build 116 miles of line, 328 customers in Buffalo County.

NORTH DAKOTA—Baker Electric Co-operative, Inc., Baker, $3,000. Project previously allotted $73,200 to build 63 miles of line, 299 customers in Benson and Pierce counties.

OREGON—Blachly-Lane County Co-operative Electric Association, Blachly, $9,000. Project previously allotted $10,000 for generating plant and $98,000 to build 87 miles of line, 307 customers in Lane County.

TENNESSEE—Southwest Tennessee Electric Membership Corporation, Brownsville, $24,000. Project previously allotted $313,000 to build 283 miles of line, 1,145 customers in Madison, Haywood, Tipton and Lauderdale counties. Middle Tennessee Electric Membership Corporation, Murfreesboro, $10,000. Project previously allotted $334,000 to build 307 miles of line, 1,129 customers in Rutherford, Wilson, Trousdale and Smith counties. Town of Dickson, $6,000. Project previously allotted $68,000 to build 65 miles of line, 322 customers in Dickson, Montgomery and Houston counties.

Construction contracts recently awarded follow:

GEORGIA—Hart County Electric Membership Corporation, Hartwell, to Richards Brothers, Carrollton, for building the first section of the project, consisting of 107.6 miles of line, $71,507.

KANSAS—Kaw Valley Electric Co-oper-

HYDRAULIC TURBINES

FRANCIS AND HIGH SPEED RUNNERS

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- PENSTOCKS
- BUTTERFLY VALVES
- POWER OPERATED RACK RAKES
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- ELECTRICALLY WELDED RACKS

NEWPORT NEWS
SHIPBUILDING AND DRY DOCK COMPANY
HYDRAULIC TURBINE DIVISION

NEWPORT NEWS, VIRGINIA

NEW TABLE TYPE LIGHTING UNIT

Model
Z A T

SHADOWLESS ILLUMINATION

Patterned to the Shape of the Working Surface

Designed to deliver high intensity illumination of the same rectangular pattern as the shape of most desks, tables and benches, the new Fostoria ZAT model Canopy Localite is the most efficient table type unit yet developed. The light source is completely shielded to eliminate reflected glare and provide properly diffused, shadowless, well distributed illumination over the entire working area. Clear seeing without eye fatigue, is made easy at every point within the worker's reach. Beautifully finished in Wrinkled Statuary Bronze or Wrinkled Black baked enamel, this modern Fostoria Localite is as attractive in appearance as in utility. Overall heighth is 21″, canopy reflector 20″ x 13″ x 3½″, base diameter 10¼″. Accommodates two 75 watt bulbs.

The Fostoria Localite line includes both Flexible Arm and Canopy type units for every industrial localized lighting need. Write for complete catalog.

CANOPY fostoria LOCALITE

THE FOSTORIA
PRESSED STEEL CORP.
FOSTORIA, OHIO

ative, Topeka, to Dan Scherrer, Kansas City, Kan., for building the first 190 miles of the project, $133,120.

MICHIGAN—Van Buren Electric Cooperative, Paw Paw, to Harris-McBurney Company, Jackson, Mich., for building entire project, consisting of 140 miles of line, $130,816.

MINNESOTA—Blue Earth-Nicollet Electric Association, Mankato, to Cater Construction Company, Kansas City, Mo., for building the first section of the project, consisting of 116 miles of line, $110,153.

TEXAS—Deaf Smith County Electric Cooperative, Inc., Hereford, Tex., contract to J. E. Morgan & Sons, Waco, Tex., for building the second section of the project, consisting of 90 miles, $105,401.

•

Power Exposition Plans Made; Moultrop Chairman

Irving E. Moultrop, formerly chief engineer of the Boston Edison Company, has been re-elected chairman of the advisory committee of the thirteenth National Exposition of Power and Mechanical Engineering at a meeting of the committee held in New York recently. Plans for the exposition, which will be held at Grand Central Palace in New York, December 5 to 10, were discussed. A large number of exhibitors has already reserved space. An attendance of more than 40,000 from the United States and from foreign countries is expected.

Other members of the committee include John H. Lawrence, Interborough Rapid Transit Company, vice-chairman; C. F. Hirshfeld, Detroit Edison Company, and P. W. Swain, editor of *Power*.

•

G.E. "Triple Play" Drive

The spring and summer sales drive on the new General Electric home laundry equipment line, as announced by Lee Wichelns, sales promotion manager, has been drawn on the plan of big league baseball competition and christened the "Triple Play Campaign." It will feature a national consumer contest, from May 16 to July 9, during which time 56 new washers and automatic flatplate ironers will be presented to women whose 25 words best tell the story of customer satisfaction with the new equipment. All details in connection with the awards will be handled by the Bridgeport headquarters.

•

Bangs Loses in Primaries

Mayor C. W. H. Bangs of Huntington, Ind., who served several months in jail for defiance of court orders in his prolonged fight to establish a municipal light plant, was recently defeated for renomination in the Republican primary election.

BROOKS *Adjustable* SAFETY CLIMBER

Reduce Equipment Costs

PARTS REPLACEABLE

Replacement features of Brooks adjustable Safety Climbers make them wise investments. Service life of original climbers is doubled. Equipment costs are cut to a minimum.

Brooks Climbers are safe, dependable. They are adjustable for perfect fit. Write today for full information.

Manufactured by

MELLING FORGING CO.
1403 Case Street
LANSING, MICHIGAN

THE SAFE ANCHOR FOR R.E.A. CONSTRUCTION!

For long life and economy in annual maintenance costs, Everstick Anchors are first choice in rural electrification construction. Their safety and dependability have been proven on millions of miles of electric lines.

ANCHORS FOR EVERY PURPOSE

The complete line of Everstick Anchors offers three expanding types in a complete range of sizes and holding capacities. Also rigid type Cone Anchors in all sizes. Made of malleable iron with its properties of strength, elasticity and rust resistance. Write for new bulletin "Everstick For Rural Electrification."

★

THE EVERSTICK ANCHOR CO. Fairfield, Iowa

Sometimes . . .

it seems that Johnny's RIGHT!

NO matter how we figure today, the facts just don't seem to come out according to the arithmetic we were taught at school.

Look at U.G.I. Last year, companies operating under its banner reached encouraging highs in sales of electricity and gas. Gross revenues increased, too. With these increases it would seem logical to expect an increase in net income.

BUT—when we reach the bottom of the income sheet we find, not the expected increase, but actually a decrease. 2 x 2 = 1 just about expresses the result.

The operating expense side of the ledger tells the story. Despite painstaking efficiency in operation and financing economies, expenses of utility subsidiary companies jumped 60% more than revenues increased. Most of these increases in expenses are beyond our control. Taxes alone have more than doubled since 1928, totaling nearly $14,000,000 last year . . . And during that same period nearly 50c of every dollar of increased revenue was absorbed by increased taxation.

In spite of this tremendous increase in taxes, $19,000,000, on an annual basis, has been passed on to customers in rate reductions since 1928.

In the face of obstacles, U.G.I. proposes to continue to try to make the figures come out right, so that it may hold to its established policy of a three-fold responsibility to its public, its workers and its stockholders . . . the interest of all three being held in equitable balance.

THE UNITED GAS IMPROVEMENT COMPANY

Dedicated to Serving the PUBLIC **1882 1938**

AMELECTRIC
WIRES
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CABLES

BARE COPPER CABLE

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"QUALITY ABOVE SPECIFICATIONS"

KENNECOTT WIRE AND CABLE COMPANY
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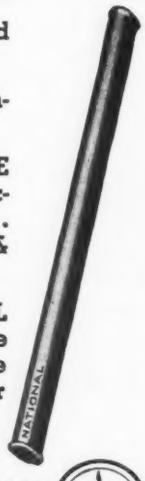
For Your Splicing Jobs

NATIONAL SEAMLESS SINGLE TUBE SPLICING SLEEVES are IDEAL . . .

They Assure—

- Line Joints that have maximum strength. .
- — that can be quickly and easily formed either in the air or on the ground.
- — that are tight as a weld and will withstand the toughest strains.
- NATIONAL SEAMLESS SINGLE TUBE SLEEVES are made of the best grade electrolytic copper and are exact to size . . . they are carried in a range from 10 B & S to 500,000 C. M.
- When you standardize on NATIONAL SPLICING SLEEVES you will find the splicing jobs done at the least expense of time and labor. Write today for samples and prices.



THE NATIONAL
TELEPHONE SUPPLY COMPANY
5100 Superior Ave. Cleveland, Ohio.
Export Distributor—International Standard Electric Corp., New York, N. Y.

U.S.S.R. Plans for Added Hydro Capacity

During the third Five-Year Plan (1938-1942) the U.S.S.R. plans the addition of 5,500,000 kw. of hydro-electric generating capacity and an added output of about 25,000,000,000 kw.-hr., according to material in the current Russian press.

Largest of the new hydro-electric generating stations will be the one at Kuibyshev, on the Volga, to have an ultimate capacity of 2,500,000 kw. Other large stations planned include those at Gyumush, with an ultimate capacity of 260,000 kw., and at Oblaket in Kazaltan, with a capacity of 280,000 kw. Work has been begun on the station at Chirchik, in Uzbeskitan, which is to have a capacity of 160,000 kw.

Basic work on the construction of an underground hydro-electric power station on the Niva river, Kola peninsula, will also be carried out this year, it is reported. This station, the Niva 3, will be located 45 to 80 meters underground and will have a capacity of 150,000 kw. High-voltage transmission lines will connect it and Niva 2 (60,000 kw.) with the Tulom station (38,000 kw.).

As a rather unique type of generating plant, windmill power plants are being built in the Crimea and Arctic regions. Scheduled to start operation this June is a 10,000-kw. unit on the hill of Bedeneh-Kir in the Crimea. The plant will use a tower 1,318 meters high and the generating unit itself will rest on oil-filled truss bearings. Some fifteen smaller wind stations are already working on Cape Desire and White Island in the Arctic.

With the completion of a 100,000-kw. steam turbine in 1937, the U.S.S.R. now has rather adequate manufacturing facilities, and it seems likely that, by and large, Soviet equipment will be used in the plants to be built.

Production of electricity in 1937 totaled 38,000,000,000 kw.-hr. Installed hydro-electric capacity at the end of 1937 was 1,250,000 kw. (Production in the U.S. last year was about 114,000,000,000 kw.-hr., U.S. hydro capacity, about 10,000,000 kw.)

Rural electrification, too, has taken great strides in the U.S.S.R. Before 1917, there were only nine rural stations, with an estimated output of 383,000 kw.-hr. In 1917-1922 three stations and 239,000 kw.-hr. were added; 1928-33, 177 stations, 5,988,000 kw.-hr.; 1933-36, 303 stations and 9,649,000 kw.-hr. Today there are 2,950 rural stations with a total capacity of 150,000 kw. Annual output in 1937 is estimated in advance of 200,000,000 kw.-hr.

DOLLARS

THAT WALK LIKE MEN

POWER HOUSES and lines and materials of the public utility industry are more than mere symbols of investment. They are "Dollars that walk like men" . . . they are the expression of jobs, of work and wages, of a living for families yesterday and today . . . and the hope for that living tomorrow.

They are milestones of national progress . . . along which moves an army of usefully employed. The public utility industry, given freedom of management, and building on experience and reliability, has continually improved and expanded these facilities . . . TRANSLATED THEM INTO OPPORTUNITY FOR WORK.

Anything which hampers or endangers the constructive program and policies of a progressive industry . . . destroys the jobs and work which they create.

Those things today which could nourish and foster the forward march of this industry, and its resultant public benefits, would give life to a vaster army of "Dollars that walk like men" . . . and set them to productive doing and living.

THE
COMMONWEALTH & SOUTHERN
CORPORATION

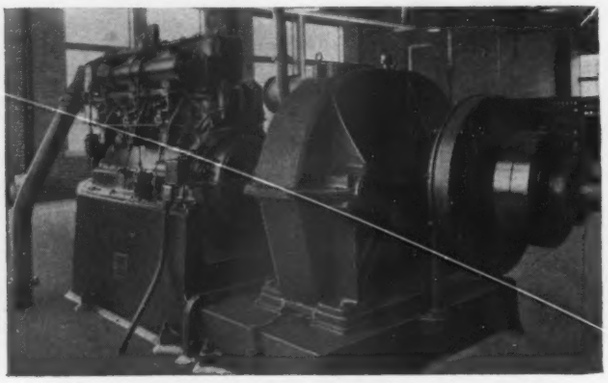
MICHIGAN • ILLINOIS • INDIANA • OHIO • PENNSYLVANIA • TENNESSEE • ALABAMA • FLORIDA • GEORGIA • MISSISSIPPI • SO. CAROLINA

PROGRESS IN METALLURGY

applied to STERLING GAS and GASOLINE ENGINES — Results in Great Savings

STERLING HIGH DUTY

INTERNAL COMBUSTION ENGINES



425 H.P., 1200 R.P.M. Sterling gasoline engine at Glen Alden Coal Company, Askam Shaft, for emergency mine fan drive,—with quick automatic starting.

Increased engine speeds—900 R.P.M. for continuous service—1200 R.P.M. intermittent duty—result in lower first cost, lesser installation costs and minimum carrying charges. Sterling engines can save you thousands of dollars and give you better service.

GAS — GASOLINE — DIESEL — ENGINES

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REASONS WHY THE

GREENLEE

HYDRAULIC PIPE PUSHER SAVES TIME AND MONEY

It makes extensive trenching, back-filling, etc., unnecessary and saves tearing up lawns and pavements.

Under usual conditions, one man can operate the levers with ease.

It has several speeds to suit varying soil conditions.

Depending on the length of base used, it will push from 4 to 7 feet with but one setting of the pipe clamp.

It is easy to handle and simple to set up and operate.

Let Us Send Complete Details

The Greenlee Pusher consists of a hydraulic unit which operates on a notched steel base. Pumping the levers sets up pressure within two oil cylinders, causing the body of the pusher to move forward against the pipe clamp. Depressing the levers releases the pressure, permitting springs within the unit to move the pistons forward to a new notch.

GREENLEE TOOL CO., 1705 Columbia Ave., ROCKFORD, ILL.

A standard generating station for rural service is a 1,500-kw. plant, serving a small rural group. House lighting accounts for most of the rural consumption, with milking and other agricultural work using some electricity.

•

Swedish System Linked Up

Junction has just been effected in Sweden between the Porjus water power station in Lapland and the networks of central and southern Sweden and lower Norrland, thus linking up the whole of the Swedish State power distribution system. So far the junction is merely provisional, but it will be definitely established next year, when the trunk high-tension line from Lapland to the steam reserve plant in central Sweden is completed. The new connection enables the Swedish Board of Waterfalls to utilize in central and south Sweden the immense surplus of electric energy generated by the Porjus station, estimated at 150,000,000 kw.-hr.

•

Wiring Program Stimulated

Rocky Mountain Electrical League's adequate wiring program recently received a vigorous thrust forward when Electrical Workers' Local 68, with a membership of approximately 200, joined in the activity. Not only will the electrical workers assist in the distribution of promotional material and bring adequate wiring to the attention of home owners and others with whom they come in contact; but, in addition they have voted a substantial sum to add to the fund with which the League and Denver Electrical Contractors' Association are administering the activity in this community.

•

Clarke Dropped as Director

At the final session of the adjourned 1937 annual meeting of shareholders of the Utilities Power & Light Corporation, held recently in Richmond, Va., Morris E. Feiwell, Irwin T. Gilruth, A. L. Jackson, F. Z. Marx, C. A. McDonald, P. B. Shaw and Henry A. Stix were elected directors by unanimous vote of Class B stockholders. Messrs. Gilruth and McDonald, trustees for the Public Utilities Securities Corporation, and Mr. Marx, trustee for Webster Securities Corporation, replaced Harley Clarke, R. R. Monroe and H. M. Hope as Class B directors. Harley L. Clarke was dropped as the result of orders issued by Federal Judge William H. Holly, who is presiding over reorganization proceedings of the utility.

A TIN CAN *is a Treasure in the Jungle*

BUT WE "WASTE" MILLIONS OF THEM EVERY DAY

A Savage in the African jungle would look upon a shiny tin can as a priceless possession to be treasured for its beauty and utility. In this country, we "waste" millions of tin cans every day. The simple answer is that the cost of making a new tin can is less than the cost of recovering and reconditioning the old.

For hundreds of years, water provided man with his principal source of mechanical power. Most people, when they see water rolling down a nearby stream, think of it as an economic waste of power in the same sense that tin cans are "wasted," but it has been said that the major water power sites east of the Mississippi could not be developed to produce power as cheaply as it can be produced by coal.

One pound of coal contains as much power as ten million pounds of water falling one foot, which gives even a layman some idea of the huge dams that must be constructed to provide an equivalent amount of water power. Today, because of improvements in the art, it requires only a fraction of the amount of coal used fifty years ago to make a kilowatt-hour, but in spite of this remarkable improvement a modern steam electric plant only recovers about one-third of the power in the coal. With coal a better source of power than water today, what will it be in future years when science learns to extract even more power from coal?

AMERICAN GAS & ELECTRIC SERVICE CORP.

One pound of coal contains as much power as ten million pounds of water falling one foot

COAL IS THE BEST SOURCE OF POWER

"saved its cost during the first year"

So writes the president of a large manufacturing company. He continues:

"We find that Ozalid Prints are easier to read and our workmen like them better than blue prints. We have often commented among ourselves about the improvement in 'our process'. In fact, we would not know what to do without it."

There you have the executive viewpoint . . . with emphasis, naturally, upon the savings effected by the Ozalid Process. Now let's see what an engineer has to say about it:

"vastly superior to blue printing"

"We have found the Ozalid Method vastly superior to blue printing and other wet processes, not only because of the clear, legible, accurate-to-scale prints, but also because of the ease and speed of making such prints. There is no delay in washing and drying or in the mixing of chemicals, and long or short runs are handled efficiently.

"Ozalid White Prints are much easier to read, showing marks and corrections at a glance. Also, changes and additions to the prints can be made in ink, making them as legible as the original printed lines."

Finally, here are typical comments from the chief draftsman's viewpoint:

"many short-cuts in drafting time"

"We particularly like the cleanliness and speed of the Ozalid Unit, as it eliminates the washing and drying of prints, which has always been a sloppy operation.

"We have found that Ozalid transparent tracing cloth offers many short-cuts in drafting time. We simply make a master ink tracing of certain drawings, omitting the variable detail, the latter being filled in on Ozalid tracing cloth prints which are reproduced from the original tracing."

These remarks on the Ozalid Process were picked at random from among several hundred enthusiastic letters recently received from Ozalid users. You, too, will be enthusiastic about this revolutionary method of print making, when you discover all the advantages that the Ozalid Process offers.

OZALID CORPORATION

354 Fourth Avenue, New York, N.Y.

The coupon below will bring you complete information.

Ozalid

Ozalid Corporation,
354 Fourth Ave., New York

Please send printed matter about the Ozalid Process, together with prices & samples of Ozalid White Prints

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Utility Construction Lower

Building and engineering contracts awarded in the 37 states east of the Rocky Mountains during the month of April amounted to $222,016,000, according to the F. W. Dodge Corporation. While this total figure was 18 per cent below the one for April, 1937 (last year's peak month), it was only 2 per cent under the total for March, 1938. Public utilities construction, amounting to $9,373,000 in April, fell somewhat behind both April, 1937, and March, 1938.

•

Incorporate Hydro Company

Approval of articles of incorporation for the Middleville Power Corporation will be recommended by Howell Van Auken, vice-chairman of the Michigan Public Utilities Commission. The company plans to build two hydro-electric plants on the Thornapple River at a cost of $190,000.

The incorporators said that power would be sold to the Consumers Power Company for ½ cent a kilowatt-hour, under terms of a tentative agreement.

•

Encourages Better Housing

Construction Industries Committee of the St. Louis Chamber of Commerce has accepted the offer made by the Union Electric Company to provide $2,000 cash prizes and pay other expenses incidental to a contest to encourage the building of better homes. The contest will cover homes built in both the city as well as the county.

•

Westinghouse Scholarships

Four college scholarships will be awarded to the highest winners in the 1938 National 4-H Rural Electrification Contest, Westinghouse Electric & Manufacturing Company has announced as donor of the prizes.

•

Franchise Transfer Denied

New York Public Service Commission has denied a petition asking authority to transfer the municipal electric plant of the Village of Churchville in Monroe County to the Niagara, Lockport & Ontario Power Company. The action also included denial of authority for the company to operate the village plant and to exercise a franchise granted to the Niagara, Lockport & Ontario Company by the village. The commission stated that the transfer would not be in the public interest.

Examine these new McGraw-Hill Books *for 10 days on approval*

***Croft's* ELECTRICAL MACHINERY** *4th edition*

Revised by George H. Hall. Offers a practical, step-by-step coverage of the operation, construction and characteristics of a-c and d-c generators and motors.
392 pages, illustrated..... $3.00

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Covers, in non-technical language, refrigeration fundamentals and the various types of household machines and systems; and gives practical instruction on how to diagnose and correct troubles.
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A comprehensive text designed to give a sound knowledge of the process of electrical measurement, admirably fitted to solve problems of electrical testing.
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***Barrows'* LIGHT, PHOTOMETRY AND ILLUMINATING ENGINEERING** *2nd edition*

Besides covering the principles of light and vision, this book also gives a full, clear treatment of practical methods for selecting lighting euipment and designing lighting systems of various types.
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☐ Barrows' Light, Photometry and Illuminating Engineering, $4.00

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AMERSEAL
NON-METALLIC
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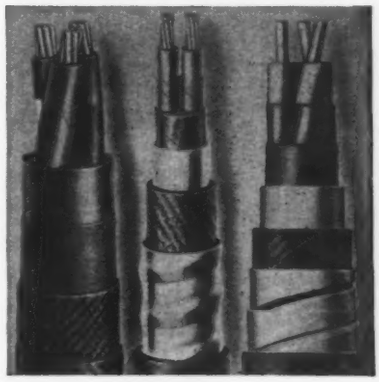
Made by American Steel & Wire Company

"MADE by American Steel & Wire Company" means a lot to buyers of electrical wires and cables. It means absolute reliability based upon years of satisfactory service from thousands of installations.

Amerseal Non-metallic Parkway Cables are designed for direct burial in earth, without external protection. In these cables a jacket of tough vulcanized rubber, covered with a heavy layer of asphalted jute, protects the insulated conductors from mechanical injury and from action of moisture, earth acids and alkalis. This unique construction gives full protection to the cables, yet you will find them light in weight, flexible, easy to handle and extremely economical.

Our Steel-Taped Parkway Cables have rubber insulated conductors protected by a lead sheath and by one or more layers of metallic armor. Use our Armorlokt or flat steel-taped metallic cables wherever added mechanical protection is necessary. For complete information, send for our new Parkway Cable catalogue.



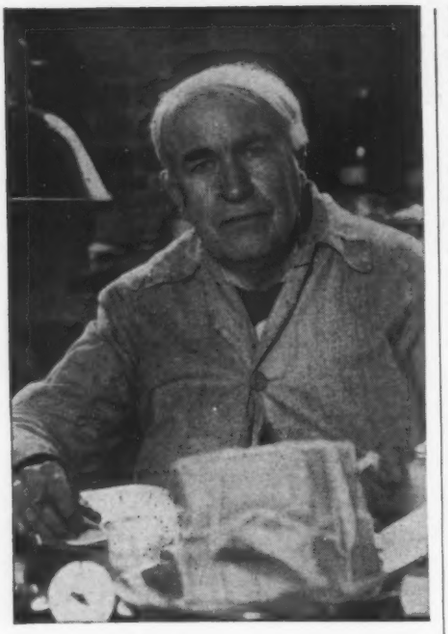
PARKWAY CABLES

AMERICAN STEEL & WIRE COMPANY

Cleveland, Chicago and New York

Columbia Steel Company, San Francisco, *Pacific Coast Distributors* • United States Steel Products Company, New York, *Export Distributors*

UNITED STATES STEEL



These words cannot be quoted too often!

"The electrical development of America has only well begun.

"So long as there remains a single task being done by men and women which electricity could do as well, so long will that development be incomplete.

"Great days are ahead . . . and electricity will have a great part to play, granted only that it can be unfettered, with full opportunity for the largest possible initiative and energy."

Thomas A. Edison

SERVICE

CONSOLIDATED EDISON COMPANY OF NEW YORK, INC.

AND AFFILIATED COMPANIES

ELECTRIC, GAS, AND STEAM SERVICE FOR BUSINESS AND THE HOME

Electric Output Hit New Record in 1937

Production of electric energy in the United States in 1937 totaled 121,049,630,000 kw.-hr., exceeding the output of 1936 by approximately 9 per cent. Of this total, 43,702,000,000 kw.-hr., or 36 per cent, was produced by water power, according to the annual report of the Federal Power Commission on "Electric Power Statistics—1937."

This report covers 3,793 plants, classified by ownership as follows: Privately owned, 2,692; municipally owned, 939; Bureau of Reclamation, 12; miscellaneous, federal, state and other projects, 42, a total of 993 publicly owned plants; electric railways and railroads, 31; manufacturing plants contributing to public supply, 77.

Installed capacity of electric generating plants in the United States December 31, 1937, totaled 37,032,112 kw., a net increase of 565,060 kw. (1.55 per cent) during the year. Although privately owned plants comprise 90 per cent of the total installed capacity, they account for only one-third of the increase (Table I). In contrast with this, the privately owned plants contributed 85 per cent of the increase in the amount of energy generated (Table II).

Of the net increase in total capacity 62 per cent was in steam, 24 per cent in water power. The rate of increase, however, in both of these groups was comparatively small and was greatly exceeded by the 12.5 per cent gain in the internal combustion group (Table III).

Table III—Installed Capacity by Type of Prime Mover (Kw.)

End of	Hydro	Steam	Int. Comb.
1936	10,339,103	25,519,062	608,887
1937	10,474,344	25,872,720	685,048
Incr.	135,241	353,658	76,161

Table I—Installed Capacity, by Class of Ownership

Class of Ownership	Type	Kilowatts			Increase Over Previous Year per Cent
		December 31		Increase	
		1936	1937		
Privately Owned *a*	Hydro	8,799,888	8,820,806	20,918	0.24
	Fuel	24,377,310	24,552,648	175,338	0.72
	Total	33,177,198	33,373,454	196,256	0.59
Publicly Owned *b*	Hydro	1,539,215	1,653,538	114,323	7.43
	Fuel	1,750,639	2,005,120	254,481	14.54
	Total	3,289,854	3,658,658	368,804	11.21
Total	Hydro	10,339,103	10,474,344	135,241	1.31
	Fuel	26,127,949	26,557,768	429,819	1.65
	Total	36,467,052	37,032,112	565,060	1.55

Table II — Production of Energy, 1936 and 1937

Class of Ownership	Type	Thousands of Kilowatt-hours			Increase Over Previous Year per Cent
		December 31		Increase	
		1936	1937		
Privately Owned	Hydro	34,897,939	38,888,061	3,990,122	11.43
	Fuel	69,539,692	73,727,977	4,188,285	6.02
	Total	104,437,631	112,616,038	8,178,407	7.83
Publicly Owned	Hydro	3,868,450	4,813,939	945,489	24.44
	Fuel	3,125,276	3,619,653	494,377	15.82
	Total	6,993,726	8,433,592	1,439,866	20.59
Total	Hydro	38,766,389	43,702,000	4,935,611	12.73
	Fuel	72,664,968	77,347,630	4,682,662	6.44
	Total	111,431,357	121,049,630	9,618,273	8.63

a Privately Owned includes electric railway, electrified railroad and that portion of the output and capacity of manufacturing plants devoted to public use.
b Publicly Owned includes municipal, Bureau of Reclamation, and miscellaneous Federal, State and other publicly owned projects.

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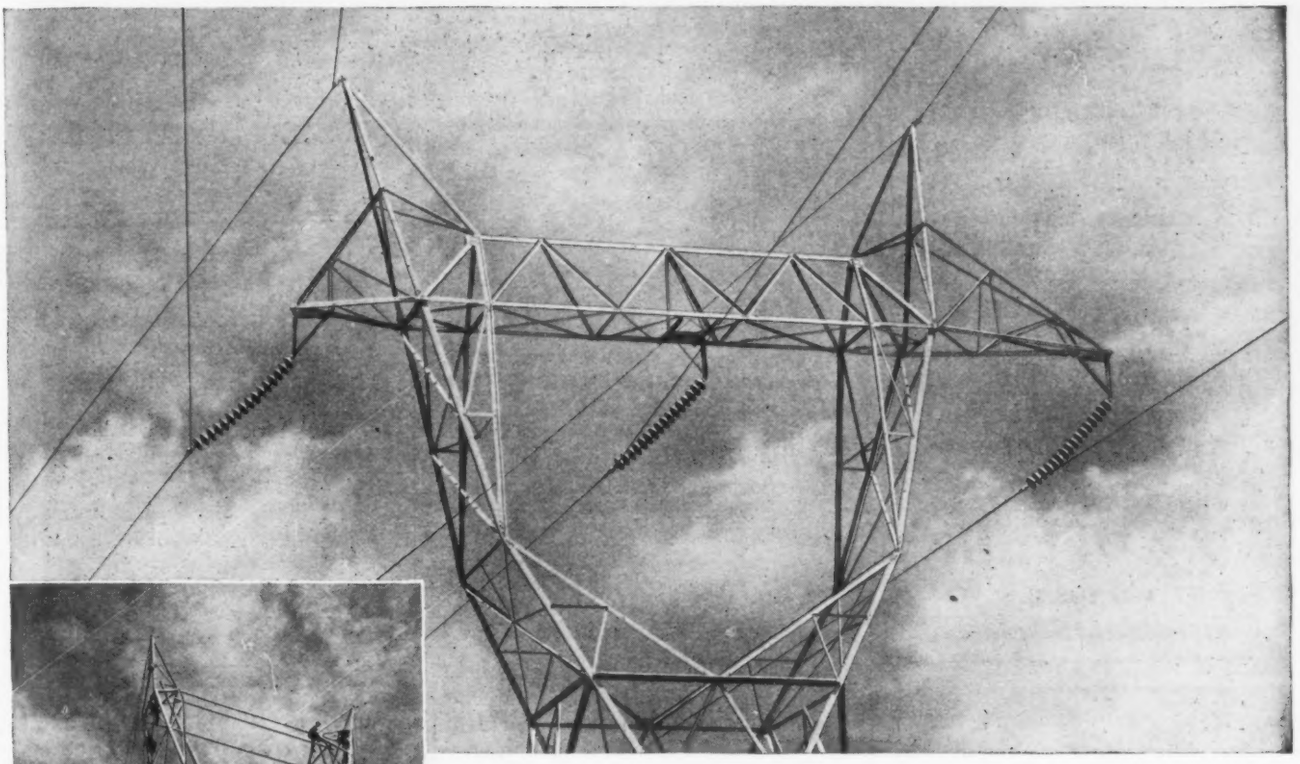

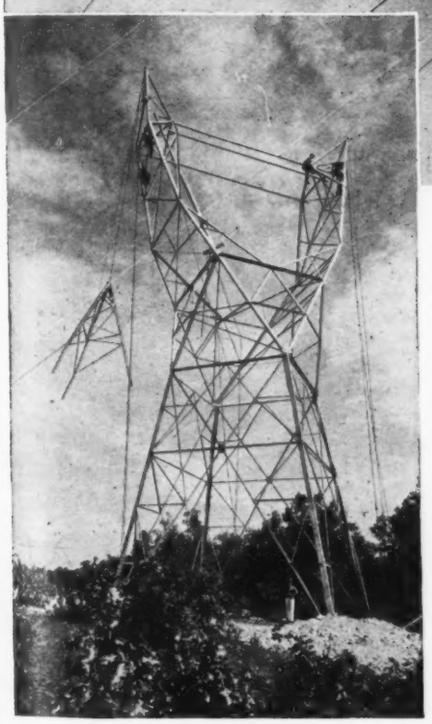

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U.G.I. Reduces Directorate

Five members of the board of directors of the United Gas Improvement Company resigned and three new members were elected at the recent meeting of the directorate. This action reduced the membership of the board from fourteen to twelve. The new members are Conrad N. Lauer, president of the Philadelphia Gas Works Company; William L. Batt, president of SKF Industries, Inc., of Philadelphia, and Harold S. Schutt, vice-president and general manager of the C. H. Geist Company, Inc., public utility operators of Wilmington, Del.

•

Buys 109 Refrigerators

Announcement has been made by the Westinghouse Electric & Manufacturing Company that the War Department has placed an order with it for 109 refrigerators. Eighty of the 109 electric refrigerators will go to the Hawaiian Islands and will complete the largest single government order of refrigerators for the Islands in several years.

•

File Reorganization Plan

A protective committee for holders of first mortgage bonds of the Mountain States Power Company has filed an application under the Holding Company Act for approval of a plan of reorganization for the company, the SEC has announced. The plan proposes in part that the existing first mortgage 5 per cent and 6 per cent bonds, which matured on January 1 be in effect extended at 6 per cent interest to January 1, 1948. Holders of the 7 per cent cumulative preferred stock would receive four shares of common stock for each share of preferred and all accrued dividends thereon. Holders of the common stock would receive nothing under the plan.

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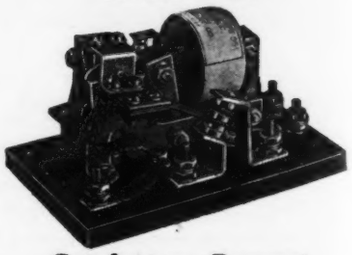

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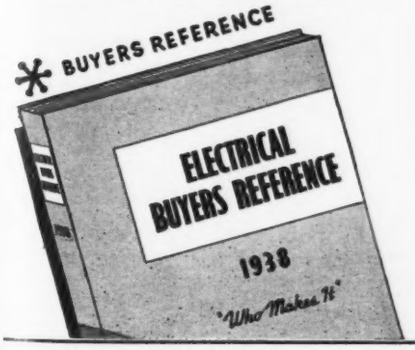

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Polaroid Lighting, Inc., is presenting a series of lectures and demonstrations in various cities throughout the country, six cities having arranged for lectures during the next two months under the auspices of local utilities or electrical leagues. Lectures are given by George W. Wheelwright, III, of the Land-Wheelwright Laboratories, developers of Polaroid.

Present schedule and the sponsors: June 6, Cincinnati, Cincinnati Gas & Electric Company; June 7, St. Louis, Electrical Board of Trade; June 10, Omaha, Omaha Electrical League; June 15, Minneapolis, Minneapolis General Electric Company; July 5–7, Denver, Public Service Company of Colorado; July 8, Utah, Electrical League of Utah.

●

U. S. Group Issues Program for World Power Conference

The executive committee of the United States National Committee of the World Power Conference has issued programs and invitations to attend the Vienna sectional meeting of the World Power Conference to be held in Vienna August 25 to September 2. Among the papers to be read and discussions to be held as part of the technical program, there will be those on energy for agriculture, small scale industry, household purposes, public lighting and electric railways.

In connection with the scientific program, many excursions are planned, some to places of interest from the technical viewpoint, others to the museums and art institutions of Vienna and other cities of southern Germany.

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EHFA Signs New Contracts

EHFA has announced that contracts have been closed with the town of Morganton, N. C.; village of Olivia, Minn.; Thumb Electric Co-operative, Ubly, Mich.; and D. S. & O. Rural Electric Co-operative Association, Inc., Solomon, Kan.

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